PUBLIC WORKS

An Engineering and Construction Journal

City **County** **State**

VOL. 63 NOVEMBER, 1932 NO. 11

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? ? ? Brainteasers ? ? ?

Civilization owes much to skillful blending of metals in alloys to obtain favorable physical properties. Alloys were probably first discovered by ancient experimenters on the order of alchemists who sought a method for transforming the more common metals into gold. Modern methods succeed in accomplishing this result in two stages. Base metals produce valuable alloys; valuable alloys bring in the gold—and all this brings on our next problem.

An Alloyed Pleasure:

Beginning with antimony, bismuth, copper, lead and tin, it is desired to make up test combinations of each of the two metals. The ingredients are each divided into five equal parts and melted down. One part of each metal is mixed with one part of each of the others, in pairs. The ten final lots weigh respectively, 13 lbs. 12 oz.; 14 lbs.; 14 lbs. 2 oz.; 14 lbs. 4 oz.; 14 lbs. 6 oz.; 14 lbs. 8 oz.; 14 lbs. 10 oz.; 14 lbs. 12 oz.; 15 lbs.; and 15 lbs. 2 oz. Since the records of original weights were lost, we shall try to reproduce the weight of each original lot, knowing that the copper weighs as much less than the tin, as the tin weighs less than the lead, whose weight exceeds the weight of the bismuth by 1 lb. 14 oz. less than the difference in weight between the lowest and highest weights.

Fundamentalists Keep Out:

The age of the earth and the span of man's inhabitation thereof have long been subjects of study, with the end nowhere in sight. Einstein recently created an uproar with his billions of years age estimate. It's about time to call in experts as are experts. According to the census estimates of the league of nations, the world population in 1930 was 2,000,000,000 and in 1927, 1,960,000,000. Using this information who can tell us the date man appeared on the jolly old planet.

The Morning After:

Now that the election is practically over we are happy to favor the request of our staunch constituent, Wheeler of New Hampshire, with an election problem. In one community the winner received half of the total votes cast and the runner-up, three-quarters of the remainder. If 120 of the votes for the winner had been cast for the runner-up, then he would have had seven-ninths of the remainder. How many votes did neither of them get?

Is This An Invitation?

Mikey and Ikey are in seclusion for a while, being embarrassed by Mrs. Mikey who has berated them plenty for having divulged her age during their last shenanigans. George S. Bloomgren, City Engineer at East Liverpool, Ohio, who claims he owes the boys a debt of gratitude, solved their last difficulty and in kindness requests that we "tell the boys to lay off their present brand and try some of the dew manufactured in the hills of West Virginia, within sight of my office window." Careful, Mr. Bloomgren, or you will acquire permanent guests. By the way, on their last birthdays Mikey was 44, Mrs. Mikey 39 and Ikey, 16. They deserve no congratulations.

The card party which got under way last month was doomed from the start. It could last only 11 innings after which everyone would want to leave.

Submitted so far as substitutes for the time honored heading "Brainteasers," are "The Brainrack" and "Poozles." Nominations are still open.

BENJAMIN EISNER

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 61

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 63 — *November, 1932* — No. 11

Facts Regarding RFC Loans

Realizing the widespread interest on the part of its readers in the terms under which funds can be obtained from the RFC and the almost universal lack of accurate information as to what the RFC is doing and what can be expected of it, PUBLIC WORKS sent its associate editor, Maj. W. A. Hardenbergh, to Washington to get the facts first hand. His report follows:

UNDER present regulations (which it is not able to change in the least), the RFC is severely restricted in the character of loans it can make and is an investment organization rather than a relief organization. Security is the prime consideration and relief a secondary one. This is partly due to what was probably incorrect information furnished to our lawmakers when the act was formulated. The statement then was made that there were literally thousands of construction projects—most of them of the self-liquidating character—which were waiting only the opportunity of selling the necessary securities. It was to care for these that the act was framed. They have not materialized. As a matter of fact, relatively few of them ever actually existed.

The RFC is anxious to find outlets for its funds, but these outlets must be limited to projects which comply with the basic laws under which the RFC was set up. It asks for applications of the type to which it can loan money, and is leaning over backward in its attempt to make such loans. But the result to date has been distinctly disappointing. Relatively few of the projects presented to it have been of such character that loans could be made.

But what about the community that needs the money for constructing a sound and necessary project which will pay for itself? Here is what the RFC says:

There must be a legal right to borrow.

There must be adequate security—to put it simply, it must be a good business proposition.

The estimate of cost and the engineering proposals involved must be *sound*..

There must be an estimate of the operation and maintenance costs, also on a sound basis.

There must be a statement of the source and extent of the expected revenue.

The last two items must be combined to show the length of time required for amortization.

All this has been given in great detail in Bulletin No. 3. In general, it will be necessary to give the information outlined there and give it fully and frankly. Helpful advice will be given freely by the RFC.

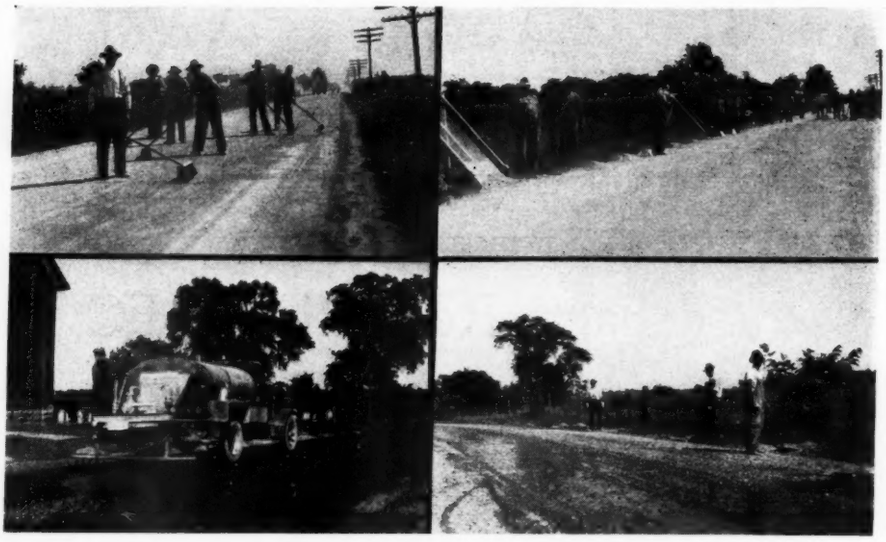
For instance, in a water district, it may be possible to apply the tax income to cover past debts, and to fund the new RFC loans by earnings, thus fulfilling the requirements regarding revenue other than taxation. Front foot assessments are not considered as taxation in general, but as a revenue from property benefited. Where water rentals are a lien on property, and the water department or water company is a going business—in the broad and sound sense—there will be no particular trouble in most cases in securing loans.

The RFC is acutely aware of the restrictions handicapping its participation in relief work, but must wait action by Congress to broaden its powers. We therefore urge municipal officials and others interested in relief through the construction of permanent, needed self-liquidating public works, to work through their congressmen and senators toward such changes in the basic law governing the RFC as may be necessary in order to carry out the original purpose and make it primarily a relief rather than an investment organization.

There is still another source from which the RFC can loan construction funds. Loans by it to states in the amount of $300,000,000 were authorized, which loans can be made quickly and with a small amount of red tape, and the money used by the states for loans for public works—highways, streets, water works, sewerage and sewage treatment, waste disposal, or other activities affording employment—and under such regulations as to loans, revenues, interest rates, and rates of return, as the states themselves may direct. Not many states have applied for such loans.

Therefore, municipal officials and others desiring to borrow money for public works should at once communicate with the governor of their state urging him to secure loans in the amount needed to care for construction requirements in each state. This avoids the necessity of delay for congressional action and may afford earlier relief.

Waiting for the relief apple to fall into our hands will bring but few results. If an RFC loan is needed in your community, there is only one way to get it—go after it. If your conditions meet the requirements of the RFC, take it up with them at once. You will get the fullest cooperation and assistance. If it doesn't, try to get RFC money through the governor of your state. And, if you aren't satisfied with the present conditions imposed upon the RFC, insist that your senators and congressmen work to have these restrictions modified; securing the cooperation of your Chamber of Commerce and of your most influential citizens in exerting as much pressure as possible on Congress to have it take such action.



Left—Sweeping by hand gave work to the unemployed.

Right—Screening the material which had been bladed off. Piles of salvaged material shown.

Left—The County's new distributor applying the bituminous material.

Right—Placing the salvaged aggregate as cover material.

Labor Benefits by Bituminous Surface Treatment in Auglaize County

By Frayne L. Combs
County Surveyor

AS in all other localities, the problem of unemployment has been a serious one in Auglaize county, Ohio. The county commissioners, George Sheipline, Emil Thieman and Frank Springer, together with the writer as county surveyor, gave the matter much study and concluded that they could relieve the situation considerably by means of bituminous surface treatment work.

After deciding to proceed with this type of work, the first question arising was the selection of the highways to be treated, and it was decided to confine this work to heavily traveled county roads.

The next question was whether to do the work by force account or contract. Force account work was selected because a greater number of men could be employed under the novel plan devised by the surveyor for doing the work. The county already owned all the equipment needed except a bitumen distributor which it was necessary to either rent or purchase. The four officials decided to purchase one which could be mounted on a chassis which the county owned, and after investigating various makes purchased a new model Littleford Bros. distributor of 500 gallons capacity.

Mixing and leveling with a multiple drag.

In this work I used the following method:

First, the loose aggregate on the roads was bladed off with a motor maintainer. I then proceeded to sweep the road with hand labor in place of a mechanical broom. Ordinarily this would be considered a very expensive operation, but we found that we got a much cleaner job in sweeping by hand. All of the old material bladed off of the road was screened and cleaned by hand labor and used back on the road for covering material. Numerous piles of salvaged aggregate selected at random were weighed to determine the amount of salvaged material and the amount of additional covering material that would be required to finish the job. After a careful survey by weighing, we found that we were salvaging an average of approximately 75 tons of aggregate per mile. This aggregate was placed in piles along both sides of the road, as shown in the accompanying photographs. The cost of aggregate delivered and placed on the roads in Auglaize county, the past year, averaged $1.30 per ton. Figuring 75 tons per mile saved at $1.30 per ton, we have salvaged $97.50 aggregate per mile. This more than paid for all of the labor required to sweep the road, screen the aggregate and place it back on the road for covering material, as an accurate cost account of the labor used for these operations showed that this averaged approximately $80 per mile. Seventy men have been employed on this work in shifts of 35 men, each working three eight-hour days per week. The job of sweeping and screening proved to be quite a dusty one, but the men were very much satisfied and gave the officers a good deal of credit by doing the job in the manner they did

(For the conclusion of this article see page 43)

Chemical Sewage Purification With Regeneration of Spent Coagulant

From a paper and discussion

By Ralph A. Stevenson and Harvey C. Banks

AN EXPERIMENTAL plant for trying out an improved method of treating sewage by chemical precipitation was placed in operation in July of this year at Palo Alto, Calif., by engineers of the Great Western Electro-Chemical Co., with the cooperation of the city of Palo Alto and Stanford University. In describing this before the California Sewage Works Ass'n, Ralph A. Stevenson, research engineer for that company, said: "We undertook the study of chemical sewage purification because we believed we had discovered a basic reaction which would allow the use of the necessary large amount of coagulant without the disadvantage of having to dispose of the resulting sludge.

"We have found it possible to regenerate a spent coagulant such as would result from the use of ferric chloride by treating the resulting sludge with chlorine in amounts of from 10 to 30% of the weight of dry solids present. The resulting coagulant forms a voluminous floc very quickly, settles rapidly, and if organic matter is present, a chloramine substance is formed that has high bactericidal properties. Under certain conditions this cycle can be repeated indefinitely," but when used with sewage, the organic matter adhering to the floc so decreases its specific gravity that it settles too slowly after about 50 cycles. In actual practice it probably would not be subjected to more than one or two regenerations.

This idea was the one tested and developed at Palo Alto, using a temporary plant built largely of wood, through which was passed 36,000 gallons of city sewage per 24 hours. This sewage was entirely domestic, with an average B.O.D. of 255 p.p.m., and 250 p.p.m. of suspended solids. The following description of the plant and the experiments is prepared from Mr. Stevenson's paper, a discussion by Harvey C. Banks, sanitary engineer in charge of one of the three 8-hour shifts by which the plant was operated, and the plans of the experimental plant.

The plant consists of three sedimentation basins operated in series, each 6 ft. wide and holding 5 ft. depth of sewage; the primary clarifier being 17 ft. 6 in. long, the secondary clarifier 12 ft. long, and the final clarifier 22 ft.; also four circular mixing tanks 4 ft. diameter, arranged in pairs. The basins are equipped with Link Belt sludge collectors (only that in the primary basin providing for scum removal). Each mixing tank contains, as a mixing device, a vertical shaft in the center supporting a cross arm from which are hung two paddles having an area of 25% of the vertical cross-sectional area of the tank. The tanks are operated in pairs in series, the paddles in the first tank of each pair rotating at 10 r.p.m. for mixing and those in the second tank at 3 r.p.m. for maximum floc development. The sewage enters and leaves the mixing tanks tangential to the flow.

The sedimentation tanks are equipped with inlet and outlet baffles designed by Prof. Chas. Gilman Hyde and found very successful in the Sacramento water purification plant. In each baffle or curtain wall are six openings, in the upper two-thirds of the inlet baffle and the upper one-third of the outlet baffle, there being a plate on the basin side of each opening which serves to dissipate the jet action. In operation, the sewage was detained 2½ hours in the first tank, 1½ hours in the second and 3 hours in the third.

Chlorine is applied by a W & T dry-feed unit.

Several combinations of operation were tried, the two giving best results being described by Mr. Stevenson as follows:

"For the first 24 hours, 4 grains of $FeCl_3$ per gallon was added to the last state of mixing for the purpose of building up a volume of sludge in the final clarifier. The ferric chloride was then decreased to .75 grain per gallon and regeneration of the sludge commenced. Ten per cent of the amount of spent sludge going to the generator was added to the first mixing tanks to weight down a portion of the suspended solids passing the primary clarifier. This sludge was removed from the second clarifier and added to the incoming raw sewage. The effluent of of the secondary clarifier was then coagulated with the regenerated sludge plus .75 grain per gallon of ferric chloride. 250 to 400 pounds of chlorine per million gallons was required to regenerate the sludge and completely satisfy the chlorine demand for the final effluent. This treatment resulted in a clear, sterile effluent and gave as

Chemical sewage purification is subject to easy, quick and positive control and hence may be adjusted to meet seasonal and daily variations in the character of the sewage; while biological methods are too easily and too frequently upset by slight overloads on the plant or by the presence of some undesirable industrial waste. The cost of a plant to give complete treatment by chemical means is much less than the corresponding costs for an activated sludge plant. With chemical purification there is freedom from odors about the plant, which therefore could be located in congested areas.

"The most familiar and valid argument against chemical sewage purification has been that tremendous volumes of sludge have been produced. We believe that we have solved this problem by using the most effective coagulants and applying them so that better results are produced with a minimum of chemical."

high as 96% reduction in B.O.D. At the end of a two weeks' run, the sludge which had been augmented by the addition of .75 grain per gallon of fresh ferric chloride had decreased in specific gravity due to the accumulated organic matter so that some floc was carried through the clarifier, and the run was then discontinued.

"The next run was planned with the idea of removing more of the suspended organic matter in the first two clarifiers so that the floc in the final stage of coagulation would have less organic matter to remove and would therefore have a longer life. The run was begun with the addition of 1 grain per gallon ferric chloride to the first mixing tank and, for the first 24 hours, 4 grains ferric chloride to the final mixers. At the end of this period, regeneration of this sludge was begun and the ferric chloride discontinued except for the one grain per gallon dose to the first mixer. The sludge from this application was removed from the second basin and added to the incoming raw sewage. The effluent of the second basin contained remarkably little suspended matter and the 30-minute chlorine demand averaged 8 parts per million. This was coagulated with chlorinated sludge and a total removal of suspended matter resulted and an overall reduction of 95% B.O.D. was obtained. After about 50 regenerations of the sludge, it became too light for quick settling and the final stage of purification was discontinued.

"The results obtained by the addition of one grain per gallon ferric chloride between two stages of settling had caused so much favorable comment that it was decided to concentrate our activities on this type of treatment for a time and the plant is now operating as follows:

"One grain per gallon ferric chloride is added to the first mixing tank, the resulting sludge is returned to the incoming raw sewage and the final effluent from the second basin is chlorinated. An overall reduction of 85% in suspended solids and 75% of B.O.D. is obtained. The effluent is opalescent but quite free from visible particles and odor and in the opinion of several sanitary engineers of note could be disposed of readily in most places.

"This intermediate treatment requires two clarifiers and two mixing tanks, and the application of ferric chloride and chlorine could be made practically automatic so that constant attendance would not be required. The addition of 142.5 pounds ferric chloride and 80 pounds chlorine per million gallons would make a very cheap and fool-proof process for this degree of treatment. The cost of constructing the simple basins required should also be quite reasonable.

"We are about to begin a combination of treatment which we believe will be the ultimate so far as the present experimental plant is concerned. In this set up, the ferric chloride will be added to the last stage of mixing, all of the sludge resulting from its use will be regenerated and applied to the first mixing tank. The sludge from the second basin will be returned to the incoming raw sewage, and the final effluent will be chlorinated. In this way a fresh, heavy sludge which requires the least amount of chlorine for its regeneration will always be had and two stages of coagulation will be possible from one application of ferric chloride. Our experiments indicate that it will be possible with this type of treatment to effect a removal of 95% of the suspended solids, complete removal of bacteria and at least a 95% reduction in B.O.D. Indications are that this treatment will require 250 pounds of chlorine and 200 pounds anhydrous ferric chloride per million gallons of sewage, which at the present market price would make the cost of chemicals for a five million-gallon plant $11.25 per million gallons."

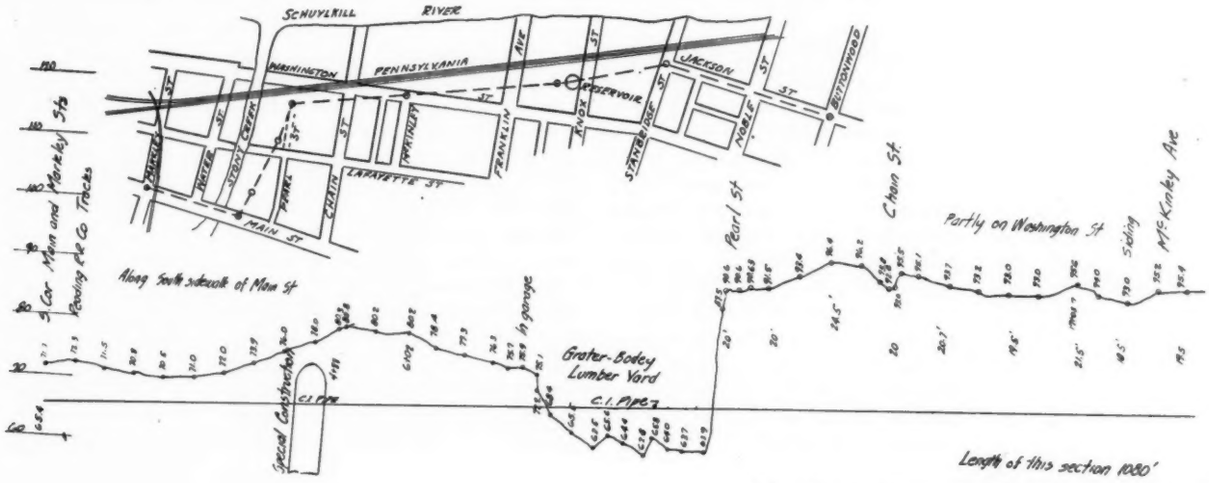
Samples of the effluent have been kept for six months in tightly stoppered bottles and no odor or sludge has developed. Buckets full have stood open to the elements and remained stable for weeks—as long as it was convenient to keep them. (The methylene blue stability test is considered worthless for this type of treatment.)

The sludge drawn from the primary tank is almost black. The solids settle out of the liquid very rapidly, forming a dense, granular mass. The sludge contains about 94 pounds of iron in the form of ferric hydroxide per million gallons.

The only power required for this plant is that for operating the mixers and the mechanism for sludge removal.

In addition to using ferric chloride and the regeneration of spent coagulant, this plant is believed to differ from and be an improvement over previous chemical precipitation plants in that it employs more effective chemical mixing and sedimentation tanks.

As compared to activated sludge plants, the construction cost would be very much less, and the operating cost, including cost of chemicals, probably would not exceed $15 a million gallons, according to Mr. Stevenson's estimate.



Map showing location of Norristown sewer and

Constructing Small Sewer Tunnel in Rock

By S. Cameron Corson

Supt. of Sewage Treatment Plant, Norristown, Pa.

In our July issue we gave a list of subjects which readers of PUBLIC WORKS wished to be informed about, among which was that of sewer and other small tunnels. We asked for contributions on these subjects, and in response to this we have received the following description of work done in a Pennsylvania city of about 36,000 population.

IT being necessary to construct a 15-inch sanitary sewer in the Southwestern District of Norristown, Pa., a considerable part of which would be in rock at depths of 20 to 35 feet, the Sewer Committee investigated the possibility of tunneling by machine. Tunneling machines were available for sand, loam, etc., but none were learned of which had worked successfully in rock. Accordingly, bids were asked for the construction on the basis of hand tunneling.

The line followed under the south sidewalk of Main street for about six hundred feet, passing through the arch culvert that carries Stony Creek. The sewer invert was about five feet below the intrados, and to carry the sewer, a sheet-iron cradle was suspended from the arch by means of 1½-inch bolts spaced 5 feet apart centers, to the bottom of which semi-circular iron stirrups were attached. Cast iron sewer was laid in this cradle and the space around the pipe was filled with asphaltic concrete and the entire structure was given four coats of hot asphalt.

From Main street the line turned south over private property for about five hundred feet, passing under a garage and then over the bottom of an old quarry used as a lumber yard, where the flow line was up to eight feet above the rock and this distance of about three hundred feet was of cast-iron pipe supported by a concrete base, concrete also surrounding the sides and top of the pipe.

Most of the remaining length of sewer was in tunnel, the first stretch being 1080 feet, from the edge of the quarry to Franklin avenue. The next 300 feet was in open cut 4½ to 12 feet deep. Then begins the second tunnel, which is 1250 feet long and extends to within 100 feet of the end of the sewer. The dimensions of the tunnel were limited to 5½ feet in both width and height, all loose rock to be removed. The grade was 0.52 percent, and very precise grading and alignment were required. The tunnel bottom was carried 9 inches below the grade of the sewer invert, and suitable material placed thereon for bedding the pipe Shafts were excavated to grade at each manhole location, and the tunnel carried in both directions from each shaft.

Several springs were tapped in the tunnel and the water was carried in a small drain pipe laid at one side of the tunnel. About fifty feet from the beginning of the second tunnel it passed under a reservoir about 50 feet in diameter and holding 8 feet of water, which was lined with concrete faced with brick. The tunnel under the reservoir (the bottom of which was about 18 feet above the top of the tunnel) was blasted with very light charges of explosives, and no cracks appeared in the reservoir during or after the work. Light charges were used when passing near foundations of dwellings also, but in spite of this, some claims had to be paid for fallen plaster and broken dishes and gas mantles—nothing serious, however.

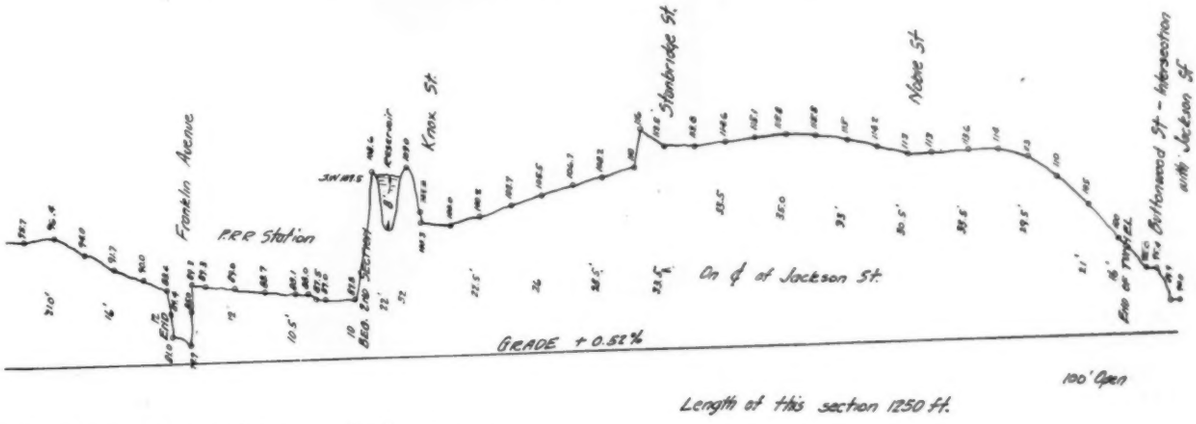
The tunnel ran nearly east and west and the rock strata here run N.E. and S.W., and the diagonal crossing of the seams made it difficult to work out the rock in an opening as small as 5½x5½; but it was done successfully and at reasonable cost.

There were never more than six men at work in the tunnel at a time, but others were employed in hoisting excavated material to the surface, building concrete manholes, etc.

Before any pipe was laid, all grades and lines were carefully checked, much of the surveying requiring use of flash lights. The transit and level were mounted on special tripods. Particular pains were taken not only to swab out each joint as laid but also to use the flash light to be sure all the mortar had been removed. As soon as the joints had set sufficiently, the pipe was covered with earth to a depth of 15 inches, which was thoroughly tamped.

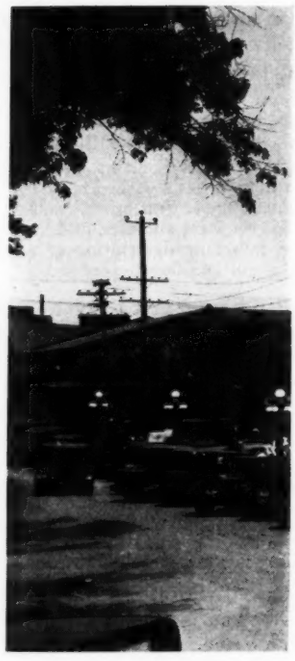
The drains discharged into sumps, one at each manhole, and pumps were kept going night and day. When the sewer had been completed the sumps were filled with concrete and the water allowed to flow down the sewer.

The sewer committee inspected the completed sewer from each manhole, using flash lights, and stated that they had never before seen a sewer with such perfect alignment and generally good construction.



profile of same. Vertical figures give depths of sewer.

Peru, Indiana, Builds Filter Plant With Water and Light Plant Earnings



A discolored, odorous and ill-tasting well water transformed into a clear, palatable, sanitary water, through the construction of an iron removal and filtration plant which provides for softening in the future, and also for the use of river water when this becomes necessary.

By CHARLES BROSSMAN
Consulting Engineer

PERU, Indiana, a city of 12,000 population, on July 31, 1932, placed in operation a new iron removal and filtration plant; the cost of which—$160,000—was paid from the profits from its municipal lighting plant and water works. In fact, the revenues from these have also, during the past two and a half years, provided funds for extending water mains, building a municipal garage and store house and a reinforced concrete pumping station. Also the the utilities furnish free water for streets, parks and fire hydrants and free lighting of streets and city buildings. For the efficient operation of these utilities and the possibility of carrying out this program credit must be given to Councilmen Zook, Unger, Beck, Monahan, Guillaume, Welke, Millhouse, Brant and Burke, Mayor John E. Yarling and the management of Floyd L. Kerns.

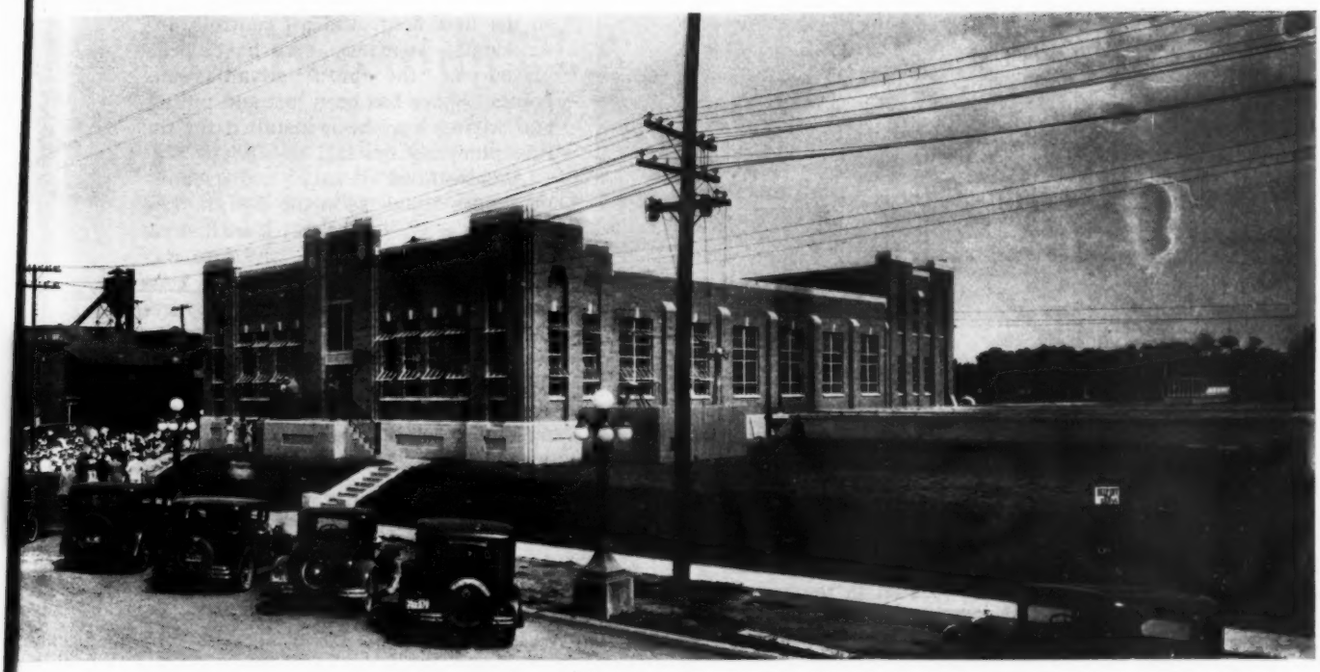
These recent improvements were made on the recommendation of the organization of Charles Brossman, which had been employed to investigate the water works system and advise concerning correcting the unsatisfactory conditions. There was much criticism of the city officials for making such a large expenditure during the depression, but in spite of this, although the plant was not lavishly furnished or equipped, it was substantially constructed, has adequate capacity for future needs and presents an appearance of substantial and dignified beauty.

View of the Aer-O-Mix units, chlorinators and stairs leading to the mezzanine floor.

Advantage was taken of the construction of this filtration plant to afford some relief to local unemployment conditions. The contract was let to C. J. Burke and the Burnip Construction Co. with the understanding that as much local labor as possible should be used, and during the nine months of construction as high as 400 names a month appeared on the pay-rolls. During one period the men were worked in three 8-hour shifts a day. It is estimated that the contractors' pay-rolls cared for at least 75 families which otherwise would have had to be supported by city or county poor relief funds. Also thousands of dollars were spent locally on materials.

The original water supply was from wells on the south side of the Wabash river, but these were gradually replaced with others in other locations until, at the time of the investigation, the supply was being derived from four wells 80 to 140 feet deep located approximately a mile north of the filter plant, extending into a water-bearing gravel, with a capacity of three million gallons a day. From these, water was pumped direct into the distribution system and a reservoir located south of the town.

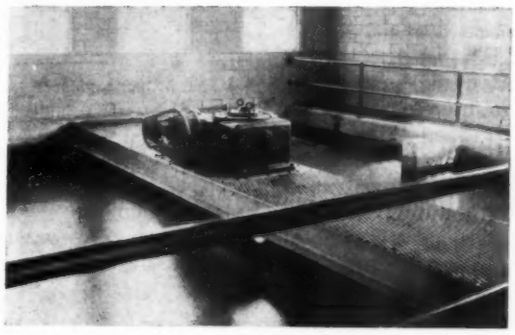
This water contained a large amount of iron which caused growth of crenothrix in the mains, odors and tastes in the water, discolored plumbing fixtures and was generally undesirable for either domestic or industrial use. The consultants carefully considered the best means for correcting this condition and also for softening



View of building which houses Peru's filter plant at time of dedication

the water; also the advisability of using Wabash river water at some future time.

The purification plant adopted provides for aeration, chemical mixing, settling and filtration. The water first passes through two 1.5 m.g. Aer-O-Mix units which operate on approximately an 8-foot head, the chamber for which was constructed of ornamental concrete. Either lime or alum can be fed into either the Aer-O-Mix chamber or the outlet of the chamber. Dry chemical is fed by two No. 10 International Filter Co. dry feed machines, one for feeding alum and the other lime, each with a hopper capacity of 10 cu-ft. and capable of feeding at the rate of 50 to 5,000 pounds of lime or alum per 24 hours. These dry feed machines are located on the mezzanine floor directly above the Aer-O-Mix units and the mixing basins.



Agitator basin and mechanical agitator equipment drive.

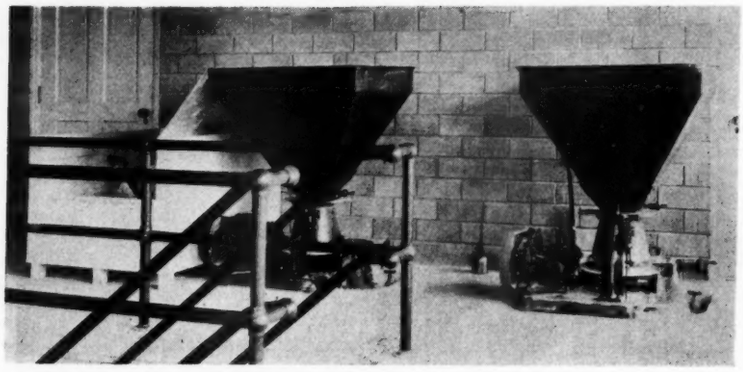
After aeration, the water passes into mixing basins, each 32 ft. long, 21 ft. wide and 15 ft. depth of water. One of these basins at present is equipped with a Dorr impeller-type agitator, and provision made for similarly equipping the other in the future. The capacity of the basins, approximately 55,000 gallons, provides a retention period of 27 minutes on the basis of a rate of 3 million gallons a day.

After being thoroughly mixed the water flows to two 55'x55'x2.5' settling basins with a side water depth of 11', through which the water can flow either in series or in parallel. One is equipped with a Dorr traction clarifier, and the other can be in the future if softening is to be used. The capacity of each basin is approximately 250,000 gallons and the two provide a 4 hr. 10 min. retention period on a 3 m.g.d. basis.

Most of the iron removed by aeration is precipitated in the two settling basins. Between them is a chamber 56'x6', provided to serve as a recarbonation chamber when this is made a softening plant, but which at present provides additional settling capacity, the basins being operated in series. In the basement is a 50 g.p.m. Dorrco sludge pump for removing the settling basin sludge.

There are six filters, each 14'x19', with a total depth of 10'6" and a water depth of 9'3"; four of which are now equipped, while all connections for the other two have been installed. These are designed for a capacity of 750,000 g.p.d. each; 3 m.g.d. with four in service or 4.5 m.g.d. with all six operating. The average consumption during the past ten years has been about 1.5 m.g.d., with a maximum, in 1930, of approximately 2¼ m.g.d. The filters are provided with International underdrainage system (Wagner blocks); 8" Simplex rate-of-flow controllers with Simplex type BCA shut-off control; International Filter Co. operating tables, with Simplex indicating and recording loss-of-head and rate-of-flow gauges. Chapman hydraulic valves are used in connection with all the filter valves. The filter medium consists of Ohio Quartz Products Co. filter gravel and Red Wing filter sand. The rate of wash for the filters is 15 gallons per square foot, or 4,000 g.p.m. per filter.

The filtered water is stored in an underground clear well 55' 6" x 63' x 13' 6" deep with a water depth of 12', having a dividing wall 6' high in the center. A 24-inch c.i. equalizing line connects the clear well with a suction well, located in the front



Dry feed machines located on the mezzanine floor.

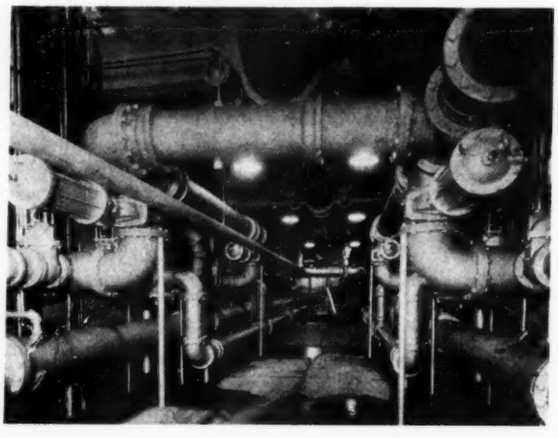
of the building, which is 10′ diameter and has connections for six suction lines to six high-service pumps (four of which have been installed), each suction line provided with a Chapman foot valve.

Chlorination is provided by means of two Wallace & Tiernan M.S.V.M. chlorinators, located in the rear of the filter building, with chloro scales placed on the mezzanine floor of the building; connections being so made that chlorine may be fed either into the filtered water effluent to the clear well, or to the suction well just ahead of the high-service pumps, or at both points.

Pumping equipment in the plant consists of Dean Hill centrifugal pumps, one 1,000 g.p.m. motor-drive pump; one 2,000 g.p.m. motor-drive pump and one 1,000 g.p.m. dual-drive pump, all against 180 ft. head. The dual drive unit is provided with a Sterling Petrel 115 h.p. gasoline engine. There is also one 4,000 g.p.m. 60 ft. head wash-water pump. The city is at all times assured of water, as a result of the installation of the dual-drive pump in the filter plant and two dual-drive pumps located at the wells.

The plant piping is so arranged that in case the wash-water pump is out of service, water for washing the filters can be obtained direct from the city's mains. All piping and accessories are arranged to be easily accessible. The pump room and pipe gallery, which occupy the basement of the building, are roomy and well lighted. All filter operating valves are hydraulically operated from the marble operating tables on the first floor, and all controls, instruments, switches, etc. have been placed at the most advantageous points. Space has been left and piping and wiring have been installed for future pumping units.

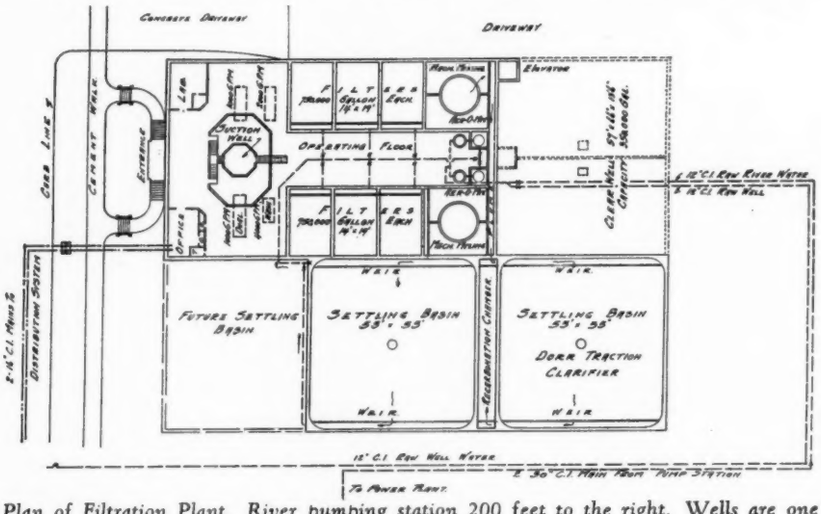
Architectural beauty and cleanliness were aimed at in the design. The outer walls are of buff brick with stone trim and ornamentation, and care was taken in surfacing all exposed concrete work. Ample window and skylight space was provided. All interior walls are of buff-colored glazed tile, with all corners rounded, which makes for easy cleaning. All structural steel members and station piping are painted with aluminum paint and all ornamental iron work is painted green, making a pleasing contrast. The floors are Terrazzo, sealed to prevent staining. An office and a well-equipped laboratory are provided for the operator. Steel sash and a featherweight concrete roof help to insure permanence and minimum upkeep.



View in pipe gallery, showing accessibility of all piping and hydraulic valves.

Extreme care was used to secure first-class construction. All concrete was carefully formed and poured and well spaded, and the plant throughout reflects the results of good engineering and fine workmanship.

Great interest has been shown in the plant, visitors from numerous states having signed the registration book, and local comment is very gratifying, the Water Department having had countless compliments on the quality of water being furnished. Complaints, which formerly were especially numerous on wash day, are ended.



Plan of Filtration Plant. River pumping station 200 feet to the right. Wells are one mile to the left.

The Batching Plant in Concrete Paving Work

IN a portable paving outfit, the paver or mixer is the key producer with which all equipment, operations and procedures must be properly co-ordinated in order to produce high operating efficiencies and low unit costs. Every piece or assembly of equipment in the outfit must be able to perform its required function with regularity within the limits set by the mixer. This is especially true of the batching plant.

The three essential functions of the batching plant or loading yard are (1) To receive the incoming stone or gravel, sand and cement, and provide for these such storage as may be necessary or desirable to iron out the fluctuations of the incoming supply so that the continuous demands of the mixer may be met; (2) to form or combine these materials into unit quantities of the size and the proportion required for the batch at least at the rate and with the regularity demanded by the mixer; and (3) to provide for the transfer of these batches or unit quantities into the hauling units with the least possible delay or interruption to the primary function of the trucks, which is to transport the batched materials from the loading yard to the mixer.

> An analysis of the data secured by means of detailed stop-watch studies on more than a hundred going jobs all serve to direct attention to this one feature: That the attainment of low unit costs in handling, batching, and hauling the materials which enter into our concrete roads is not a matter of chance or of luck, but the result of careful advance planning and constant supervision by an able and alert management.

The usual batching plant for supplying a 27E paver capable of producing at a maximum rate of from 45 to 55 batches, or from 50 to 70 cubic yards, of concrete per hour, consists essentially of a crane with a 1 or 1¼ yard bucket, one or two bins equipped with batch-weighing devices, and a cement loading platform or a cement bin, all generally located at a railroad siding where there is room for ample stockpiles; and if sack cement is used there must usually also be room for a cement shed with a capacity of at least one day's supply.

The Crane

The function of the crane is to unload materials from cars to bins and stockpiles, and, in the absence of cars, to supply the bins from the stockpiles. It should be able to maintain a regular cycle of not to exceed 25 seconds per load of 1 to 1¼ cu. yds. from stock pile to bin or 30 seconds from cars to bins. Cranes in good condition on ten jobs averaged 7.8 seconds in loading sand into 1¼ yard bucket, 8.0 in swinging, 2.2 in dumping, 7.6 in return swing; a total of 25.6 seconds. The buckets averaged .88 cu. yd. per load. When handling gravel the cycle averaged 26.7 seconds with .76 cu. yd. per load.

If all materials must first go to stock piles, some night unloading of cars may be necessary. Speed may be increased if the crane operate on a runway 6 or 7 ft. high; which runway may be made of coarse aggregate, to be fed into the bins during the last day or two of the job.

If one or more pits can be located beneath and on the yard side of the track, the materials, shipped in dump-bottom cars, can be dumped into these and fed to bins or stockpiles by belt conveyor or crane and no time lost cleaning out cars and spotting new ones.

Bins

If the coarse aggregate is of two sizes, a 3-compartment bin should be used. The bin capacity should at least be sufficient for one hour's run of the mixer, to absorb minor crane delays.

Cement

It is usually desirable to construct a platform along the siding so that cement bags can be trucked from the car and dumped directly onto the truck. This platform should be about 6 in. higher than the body of the truck, which should drive very close to it. A depressed driveway may become a bog hole in wet weather; this should be avoided by proper grading or paving.

The most common way of handling bulk cement is in 2-wheel buggies of either end or bottom-dump type, capacity 600 to 650 pounds. The platform should be long enough to unload two cars simultaneously. That part of the buggy track which extends out over the truck should be hinged at the platform edge and provided with a counterweight so that the push of the advancing buggy wheels will cause it to lower to a horizontal position, but rise to an angle of 75° or 80° when the buggy is withdrawn. The cement should be dumped into a canvas boot long enough to reach the aggregate in the truck, and the sides of the boot should be extended above the platform to protect the falling cement from the wind.

When bag cement is used, a shed of about 550 sq. ft. should be provided for keeping enough in storage to provide against delays in arrival of cars. This is most conveniently a part of the loading platform.

For transporting bulk cement by truck to the mixer, three general methods are in use; Spreading it over part of the aggregate and placing the rest of the aggregate on top; or dumping it on top of all the aggregate and covering with a canvas or tarpaulin; or carrying in a special container on the truck. The first is generally the fastest where two aggregate bins are used, the cement platform being located between the two. For the second, it takes 15 to 30 seconds to roll back or tie down the tarpaulin. Some contractors move part of the loaded aggregate to the side of the truck, deposit the cement in the center, and replace the aggregate on top of it, requiring two men and a delay of 30 to 60 seconds per batch. Loading special containers generally requires about 25 to 45 seconds per batch.

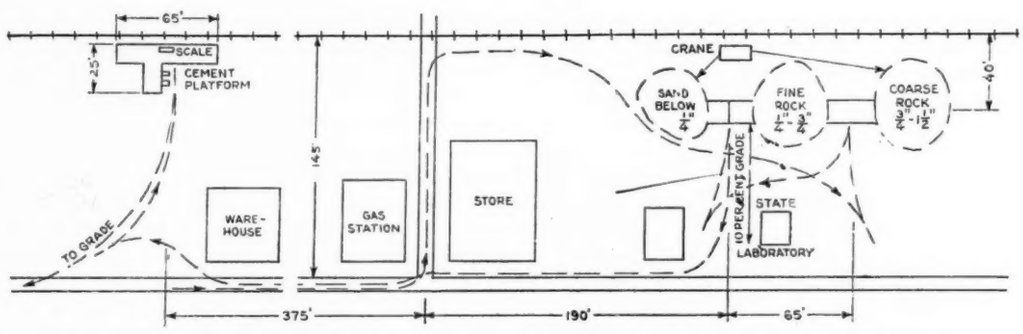
Where bulk cement is handled mechanically it is desirable to provide bin capacity for a full day's run;

and so erect the bin that the trucks can drive straight through under it.

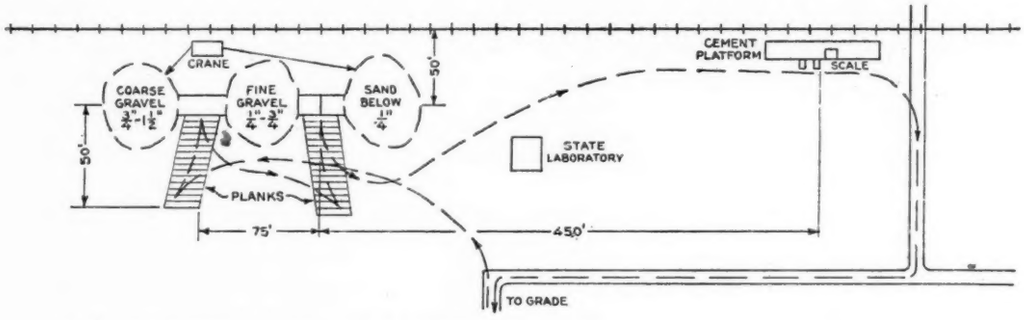
Loading Yard

The loading yard must provide for routing the trucks through it by the shortest and most direct route possible, for each minute added to the time a truck must spend in the yard adds 2 to 5 cents per trip to the truck costs. But above all, it must provide for maintaining a regular, uninterrupted service; for delays in regular arrival of trucks at the mixer entail a cost of 75 cents to $1 for each minute the mixer is idle. A third requirement is that no regular single stop in the yard will exceed a period equal to the length of the mixing cycle multiplied by the number of batches carried by the truck. No mud holes should be tolerated, or other condition which may hold up trucks, directly or indirectly.

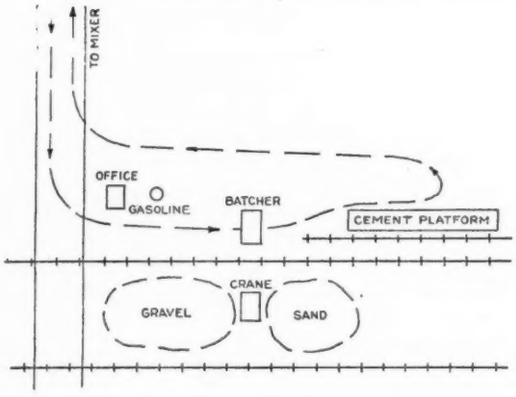
To study the actual effect of yard layout and management in determining the length of time required for each vehicle to take on its load and pass through the yard, 24 rather typical jobs were selected, 12 with fairly good yard layout and able management and 12 with poor yard layouts and fair to poor management. The result of the study is given in the table on page 40.



A TIME-CONSUMING YARD LAYOUT; TWO SIZES OF COARSE AGGREGATE; BULK CEMENT HANDLED WITH BUGGIES.



B. IMPROVED YARD LAYOUT; TWO SIZES OF COARSE AGGREGATE; BULK CEMENT HANDLED WITH BUGGIES



C. CONVENIENT YARD LAYOUT FOR ONE SIZE OF COARSE AGGREGATE AND BAG CEMENT

EXAMPLES OF YARD LAYOUT

A and B show the layout of two yards using two bins and bulk cement. C shows an extremely simple layout for a batching plant using one size of coarse aggregate and bag cement. The table gives the yard time constants for these three layouts.

Yard time constants, in seconds, for layouts shown herewith.

Item	Layout A 1-batch trucks	Layout A 2-batch trucks	Layout B 1-batch trucks	Layout B 2-batch trucks	Layout C: 2-batch trucks
Loading aggregates ...	10	68	11	70	27
Loading bulk cement and adjusting tarpaulins ..	33	*40	33	53	..
Loading bag cement	..	..	..	..	37
Driving within yard ...	90	110	51	59	71
Turning and backing ...	74	97	22	30	..
Fixing batch boards	..	18	..	19	..
Total net yard constant.	207	333	117	231	135
Average waits and delays	..	..	..	..	15
Total gross yard constant	..	..	..	..	150
Driving distance in yard	800'	800'	875'	875'	250'

Three examples of yard layout, and time constants for same.

Water Consumption Averages and Anomalies

WATER consumption rates form the basis of design of size of pumps, pipes and purification plants and numerous other items of water work systems; but there seem to be no universally or even generally applicable laws by which to estimate future rates for a given city. Consumption rates are generally reduced by introduction of meters, but in a number of cases they have increased after (though possibly not because of) a considerable increase in percentage of services metered.

It might be thought that the lower the meter rate, the greater the consumption rate. But in Ohio, municipalities which purify or soften their water charge 5 to 10 per cent more than those which do not, but have consumption rates 30 to 40 per cent higher per capita.

The latter illustration is derived from recently published data collected by the Ohio Department of Health relative to meter rates and water consumption in 266 communities of that state. It was found that, in cities of 15,000 to 50,000 population, the daily consumption per capita averaged 137 gallons for cities 50 per cent metered or less and 105 for those more than 50 per cent metered. In the case of communities of 5,000 to 15,000 population the consumption averaged 147 and 81 gallons respectively; and for places of under 5,000 the rates averaged 80 and 59 gallons. Concerning consumption rates, the report says: "It is evident from the above that where metering is more complete the per capita water consumption increases with the population. Generally speaking, however, it is found that the water consumption per capita is less in a municipality having a large percentage of metered services than in a municipality of similar size having a small percentage of metered services. There are a number of factors which have considerable effect on the per capita water consumption in a municipality, whether or not the water services are metered. Among these factors are:

1. Manufacturing use of water.
2. Private industrial water supplies.
3. Private domestic water supplies.
4. Condition of the distributing system.
5. Character of the water.
6. Extent of the sewer system.
7. The cost of water.

"One or more of these factors may so greatly affect the water consumption in a municipality that the amount of water used per capita will be abnormally large or abnormally small."

From the tabulated data in this report we have calculated the daily per capita consumption rates, being averages for an entire year, and the percentages of this for the month of minimum consumption and the month of maximum consumption. (See table.)

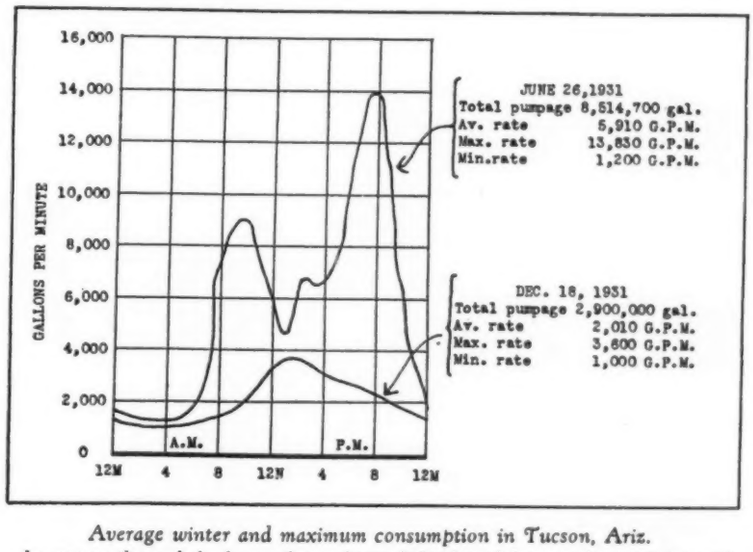
But there are striking departures from these averages. Wadsworth, about 6,000 population, had a minimum month average only 37 per cent of its yearly average, and Troy only 24 per cent.

Maximum and minimum rates for any one day or hour during the year show still greater departures and vagaries, as brought out in a paper published in the October issue. Abnormal individual rates in a number of cases have been explained by the water works superintendents in reply to our requests for further information. High maximums in 70 per cent of these cases were attributed to lawn sprinkling; the others to sewer flushing, large fires or unusual local conditions. Among the last was Lake Forest, Ill., where, on several days, the peak demand was 6 times the normal because of "large private estates and private swimming pool connections that are in use by summer consumers."

Typical of the excessive hourly rate due to sprinkling was Winona, Minn., where "this particular hour was in the evening of July 27, 1931, from about 6:30 to 7:30, when very excessive water was used (632 per cent of the average) for sprinkling and otherwise

Daily per Capita Consumption Rates, and Percentages of These in Months of Minimum and Maximum Consumption
The East and Midwest

Population group	Over 50,000	50,000 to 15,000 with filtration or softening	50,000 to 15,000 without either	15,000 to 5,000 with filtration or softening	15,000 to 5,000 without either	Under 5,000 with filtration or softening
Per capita, yearly average	114	121	87	96	72	84
Per cent, minimum month	94	90	88	93	85	86
Per cent, maximum month	111	110	118	117	122	118



Average winter and maximum consumption in Tucson, Ariz.
In summer the peak loads are due to heavy irrigation of lawns and trees before and after the hot hours of mid-day. In winter the consumption is mostly domestic.

on account of the extreme dry weather and excessive heat. This was the record of this Department since its establishment."

Abnormally low rates were in the majority of cases attributed to a large industrial consumption, which is generally maintained at a fairly uniform rate. In Centerville, O., 65 per cent of the pumpage is used for commercial purposes which have practically a 24-hour demand. The maximum hourly rate was only 140 per cent of the average, but if we consider that all the variation was due to the 35 per cent non-commercial consumption, *its* maximum was 4 times its average, which is a little above the average of the maximums of all the cities considered.

Waste, especially when in the form of leakage, is fairly constant and has the same effect as commercial use.

Two cities, one in the east and one in the west, furnished especially valuable and reliable information. Tucson, Ariz., measures all water pumped by means of a Simplex recording meter at the main plant and a carefully calibrated pitot tube at the smaller peak load plant. During the fiscal year 1931-'32, 95.5 per cent of the services were metered, and these meters accounted for 81 per cent of the water pumped, and apparently 9 per cent more was paid for by the flat rate users. The maximum hourly rate was 433 per cent of the yearly average, the maximum daily rate was 185 per cent, and the maximum monthly rate 149 per cent. The curves for the day of maximum consumption and an average winter day are shown herewith.

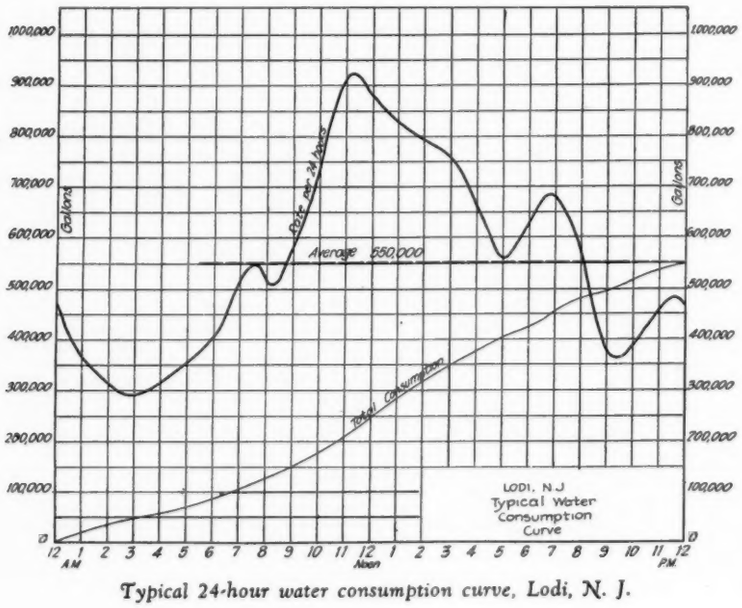
All water used by Hartford, Conn., passes through a single supply line on which is a venturi meter which records the rate of consumption continuously. The maximum hourly consumption during the past seven years was 225 per cent and average of the maximums for each of the seven years was 190 per cent. The maximum daily average during that period was 141 per cent, and the average of the seven daily maximums was 129 per cent.

Why the maximum rate per hour is generally double the maximum per day is shown by the accompanying typical 24-hour curve of consumption at Lodi, N. J. (kindly furnished by Benjamin Eisner). Here the maximum hourly rate is 920,000 g.p.d. and the average is 550,000. The 3 A. M. rate indicates waste or 24-hour use of about 200,000 g.p.d.; and if we deduct this, we have 720,000 and 350,000 respectively, or an hourly rate a little over twice the daily.

In estimating future consumption, it would seem logical to use as a basis the general averages obtained from our questionnaires—daily peaks 1.5 to 1.6 times the yearly average, and hourly peaks 3.0 to 3.5 times; and modify these to provide for local peculiarities, such as need for general sprinkling in dry weather, heavy draughts for industrial purposes such as filling locomotive boilers; or reduce the excess rates when high per capita rates are assumed which allow for waste or industrial use.

With the operation of the quota in immigration, the depression, birth control and other causes, the rate of growth of the United States is diminishing and will probably remain, for some years at least, appreciably lower than it has been in the past.* In addition to this, the population drift seems to be away from rather than toward the large cities. These tendencies should be borne in mind in estimating future population; but on the other hand, domestic conveniences which consume water are increasing in general use, a large percentage of citizens live in detached houses with lawns, which they sprinkle; and these tendencies will be considered as offsetting the slowing down in population increase.

Other changing conditions are the substitution of gasoline and electric power for steam boilers; the departure of the street sprinkling cart with the advance of hard-surface or bitumen-treated pavements; reduction of loss and waste of water by better construction, waste surveys, metering, and by a general improvement in the quality of water works management.



Typical 24-hour water consumption curve, Lodi, N. J.

Soft Water Cause for Joy

Initial operation of an iron removal and water softening plant as the latest improvement to the village waterworks is causing much satisfaction among residents of Genoa, Ohio, who have struggled long with the inconvenience of 450 ppm. of water hardness, says the Ohio Health News. Report of results attained has not reached the State Health Department but the plant was designed to remove about 85 percent of natural hardness. The Genoa *Gazette* is reported as being so enthused over the improvement that it suggests the observance of an annual "hard water day," so that future residents, by actual experience with the natural water, will be made to realize the blessings derived from the softening process.

* The *Statistical Bulletin* of the Metropolitan Life Insurance Co. says the birth rate for the United States dropped from 18.9 in 1930 to 17.8 in 1931 and will probably be below 17 in 1932; and that, failing an increase in the birthrate, "it appears inevitable that, at some not very distant date, our population will not only come to a standstill but will actually decline, now that accretion from outside by immigration is precluded."

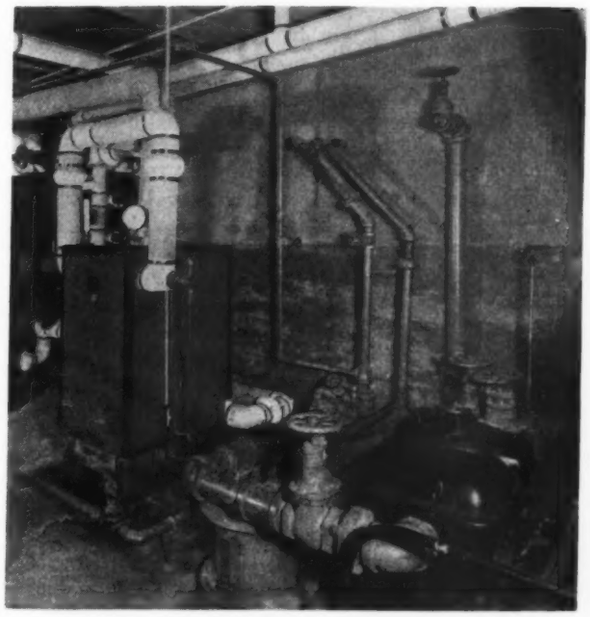
Mechanical Equipment in Sewage Treatment Work

By A. Prescott Folwell
Editor Public Works

VI—Separate Sludge Digestion and Gas Utilization

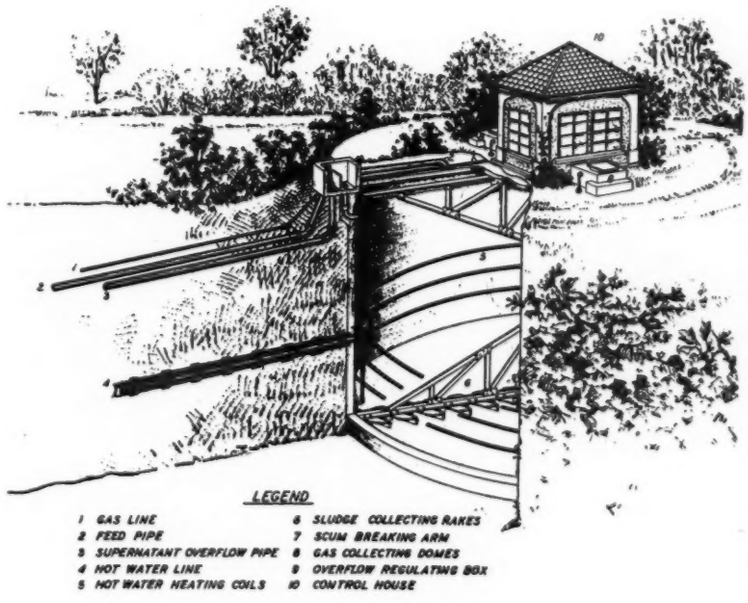
"THE PURPOSE of digestion is to render the solid portion of the sewage non-offensive and drainable; reduction in volume and weight of the solids is a highly desirable secondary consideration," says John R. Downes. Well digested sludge is, according to the Committee on Sludge Digestion of the Am. Soc. of Civil Engineers, uniform in texture, black or dark colored, with no visual evidence of fresh sewage solids such as feces, paper or grease; dense, with a moisture content generally not over 90% although sometimes reaching 95%; practically free of objectionable odor but having a faint tarry one as drawn and an earthy or musty one after dewatering; should drain well on sand beds; contain a substantially higher percentage of mineral matter than did the fresh sewage solids, at least about 50% less volatile matter, substantially less B O D, and a pH usually between 7.0 and 7.6.

Digestion is generally secured by retention of sewage sludge in tanks. The old septic tank as a sludge digester was succeeded by the bottom of the Imhoff or other two-story tank, and this is being supplanted by separate digestion tanks. These have been made of all shapes—round, hexagonal, square, and several times as long as wide. There is not space in this article to discuss the relative merits of the different shapes.



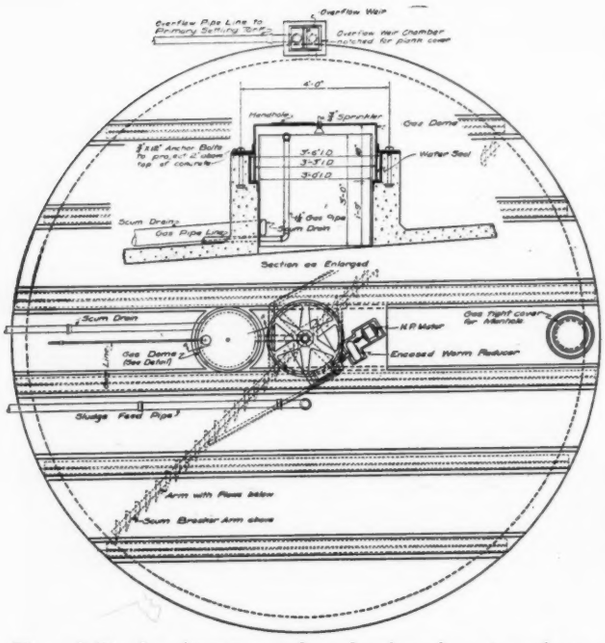
Gas utilization equipment at Middletown, N. Y., installed by Pacific Flush Tank Co. Boiler at left.

The "Committee on Sludge Digestion" of the Am. Soc. of Civil Engineers, in its latest report, said that "local factors are so different that no standards (of capacities for sludge digestion tanks) could be stated." However, constants are suggested as applicable for estimating for three different conditions of operation, using an assumed value of 200 p.p.m. suspended solids in the sewage: 1—For continuously controlled operation with daily addition of solids—0.80 cu. ft. per capita. 2—Providing for some sludge holding after complete digestion—1.32 cu. ft. per capita. 3—Uncontrolled digestion and storage of winter accumulation—3.39 cu. ft. per capita. The cost of separate digestion tanks varies, according to this committee, from $20 to $176 per 100 cu. ft. but generally ranges between $40 and $55.



Sketch of new type Dorr digester

Thorough digestion may require weeks or months and the size of tank must be sufficient to hold the amount of sewage solids accumulating during that period together with the much greater amount of diluting water. Anything that will reduce the duration of digestion makes possible the reduction of size of the tank. Such aids to digestion are heat; regular



Plan of Simplex digestion tank and enlarged section of gas dome.

frequent additions of fresh sludge and immediate seeding of it by mixing digested or digesting sludge with it; breaking up and submersion of scum; and maintenance of a pH between 6.9 and 7.6.

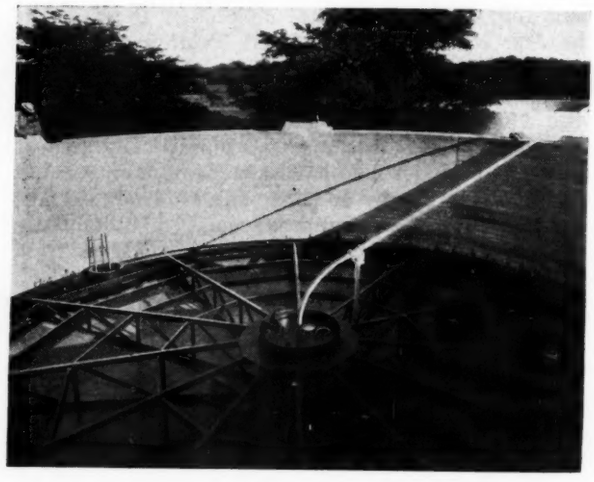
Provision must be made for introducing fresh sludge and withdrawing that digested, also for removing the liquid displaced by the fresh sludge. Modern tanks also have many other desirable or convenient features. A roof over the tank helps conserve the heat, conceals the objectionable appearance, prevents the escape of odors and permits collection of gaseous products of combustion, which gases have a high heat value. Hot water coils in the tank permit heating the contents, generally by means of water heated by burning the gas collected. Revolving arms, plows, etc. break up the scum and move the sludge over the bottom to a central sump; also these or pumps are used for mixing old sludge with the fresh.

A temperature above 70°—preferably 80° to 100° F.—is necessary for rapid digestion. Several experimental and a few operating "thermophilic" tanks raise the temperature to 125°-150°, whereby complete digestion in less than ten days is claimed. The more common method of heating the sludge is to pass hot water through pipes placed around the inner sides of the tank, and conserve the heat by banking earth around the outside of the tank and sometimes on top of the roof. Gas is generally collected by means of one or more domes or small inverted tanks in the roof, from which a pipe leads it to the boiler where the water is heated. Experiments indicate that while 120 days are required for thorough digestion at 55° F. and 42 days at 68°, this can be reduced to 30 days at 82°, to 12 days at 120° to 140°, and to 11 days at 170°. In other words, the tank can be reduced more than 50% in size for winter operation if the temperature be maintained at 70° to 80°. In some cases the slow digestion at winter temperatures is compensated for by providing cheap storage tanks for temporarily holding a part of the raw sludge.

The liquid displaced from the digestion tank when raw sludge is introduced is high in solids and is generally returned to the raw sewage as it enters the plant. This necessitates pumping this, unless the sludge or sewage has already been pumped. Power for this pumping can often be obtained from the sludge tank gas. The pumps used will be considered in a later installment.

The gas given off during digestion is generally 60 to 78% methane, which is explosive when mixed with between 19 and 8 times its volume of air. The gas collected from the tank should therefore be handled with care, but if the precautions in handling the gas described below are adopted, there need be no hazard of fires and explosions about digestion plants.

At least two companies have worked out a complete



Downes floating cover, resting on supports at its lowest position. Roofing still to be placed. Gas dome and pipe in center. At Decatur, Ill.

plant for digesting sludge and safely collecting and utilizing the gas. One just placed on the market by the Dorr Company is shown diagrammatically by the accompanying drawing, and the sketch shows the details of the tank itself. "The Dorr digester is a special mechanism for improving the distribution of sewage solids in digestion tanks, providing chemical, physical and thermal conditions propitious to rapid and complete digestion and facilitating the discharge of the digested solids from the tank. The basic and important Imhoff patent covering recirculating or mixing digested and raw sewage sludges for use in a digester is owned by the Dorr Co., Inc., as also is the Morgan patent which covers the return of supernatant from the digester to a preceding clarifier." The company also makes an open tank, the gas from which is not collected, but the gas collection type is preferred. A revolving vertical shaft in the center of this tank carries radial arms at the top to break the scum, and at the bottom radial arms equipped with plow blades just clearing the bottom of the tank which keep the sludge in a well stirred condition and sweep it to a central discharge port. Domes in the tank cover collect the gas, which is piped to the heating equipment. Hot water coils are supported on the interior walls of the tank. The shaft and arms are driven by a motor housed in a small building; building, motor and tank cover being all supported by the same beams.

The collected gas is burned under a thermostatically controlled gas boiler, the hot water from which is circulated by a centrifugal pump through the heating coil in the tank. Meters, vents, traps, etc. are provided to assure safe and dependable operation.

A similar equipment of shaft with scum-breaking arms at the top and arms at the bottom carrying plows is made by the Simplex Ejector & Aerator Corporation for use in digestion tanks. The arms revolve at one-twenty-fifth of a revolution per minute. The concrete roof is supported by six I beams. A gas dome is set into the roof near the center, a section of which is shown in the illustration.

A circular tank with scum breakers and "sludge dislodging" arms at the bottom is made by the Hardinge Company also; but it is distinguished from the others chiefly by the construction of the tank, especially the dome roof. This roof uses a special method of steel reinforcing in its construction, and is not only self-supporting, but also supports the revolving mechanism in the tank and such backfill as is used for insulation purposes. In the construction of the dome roof, steel bands are placed around the dome abutment after the dome has been cast, and are tightened by means of turnbuckles before the forms are removed from the underside of the dome roof. This method of construction is claimed to be very economical as compared to roofs and mechanisms supported by girders or trusses, particularly in sizes above 40 feet diameter. Other advantages claimed are excellent architectural appearance and gas-tightness of the roof. The power required varies from 2 to 5 horsepower. The mechanism is so arranged that the sludge-dislodging arms

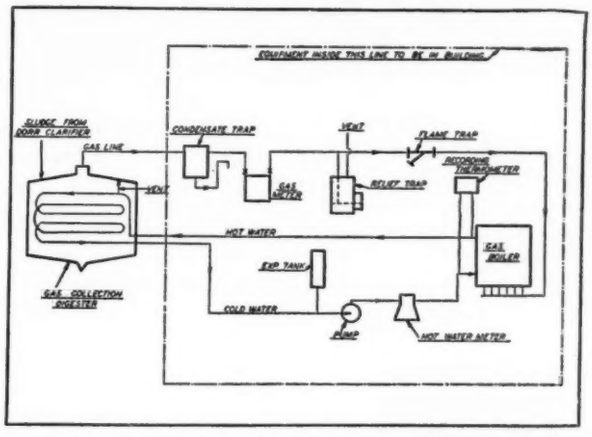


Diagram of arrangement of heating equipment used with the Dorr gas-collection type Digester.

can be raised several inches above the floor when desired.

Another tank which is distinguished by its roof is one using the Downes floating cover, furnished by the Pacific Flush-Tank Co. In addition to the advantages of a permanent roof, the floating cover, which rises and falls with the liquid contents, is aimed to prevent air from collecting on top of the scum, and by keeping the scum submerged, its digestion is facilitated. The cover, being made of welded steel, is gas-tight; and as it floats and the gas collects under it, it maintains a constant gas pressure. The cover is made of structural steel trusses, a steel ceiling plate in contact with the sludge, a waterproof roof on top of the trusses, a

Two of three 75-foot Hardinge dome roof digestion tanks at Wichita, Kans.

gas dome, and a vertical rim plate which just clears the side wall of the tank and extends about 2.5 feet below the ceiling plate to prevent gases escaping and scum from rising into this narrow armular space between the cover and wall.

For utilizing the gas in heating water for warming the sludge, equipment similar to that furnished by the Dorr Company is necessary. An arrangement suggested by the Pacific Flush-Tank Company is shown on page 47. The makes of equipment named are those which that company have found to be satisfactory. The "P.F.T. combination flame trap" is made by that company to combine in compact form the condensate, relief and flame traps. The diagram shows:

Gas meter. Loss of head not to exceed 0.5 inch of water pressure. Materials used must resist corrosive action of digestion tank gas. "Ironclad" recommended.

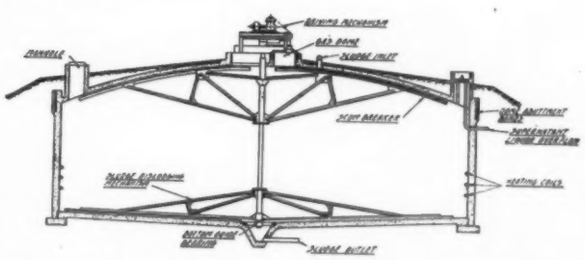
Thermostat, connected to boiler for controlling water temperature. Robert Shaw recommended.

Hot water boiler. Should be especially designed for burning sewage gas, which has a heat value of 700 to 780 B.t.u.'s and operates under about 2 in. of water pressure at the boiler. In addition to the thermostat, the boiler should be equipped with non-throttling hand control valve, altitude or pressure gauge, thermometer, automatic secondary air regulation, and gas pressure regulator (the last not required if the P.F.T. combination unit is used). The "B-Line" boiler is recommended.

Water meter in the return line of the heating system. Recommended but not necessary. A by-pass should be provided.

Circulator, such as the Thrush, gives better results than gravity circulation. It should be placed at the lowest point in the return line.

A two-pen circulating water temperature recorder, such as the Bristol.



Hardinge sludge digester in dome-roof tank, showing pre-stressed steel reinforcing rods around dome abutments.

Expansion tank in the hot water circulating line.

Waste burner for burning excess gas from pressure relief chamber. Preferable to discharging into the air. P.F.T. burner recommended.

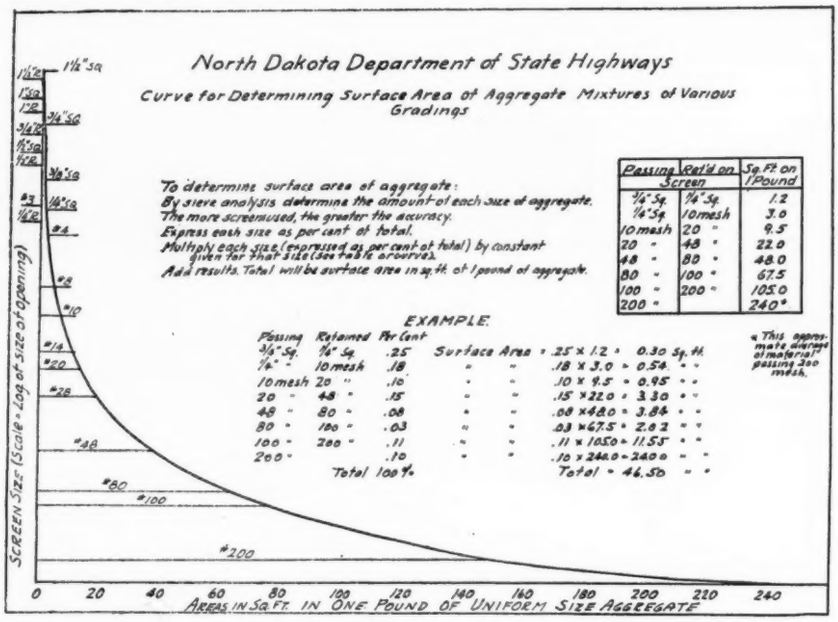


Fig. 1. Curve used by North Dakota State Highway Department for determining surface area of aggregate mixtures. In conjunction with Fig. 2, these data are employed for determining correct oil mixes.

Plant Mixes and Plants

Fourth in a series of Articles on Low Cost Bituminous Roads

THE plant-mix type of construction has been used to a considerable extent in the west. California has been one of the leaders; North Dakota now uses the plant-mix type almost exclusively and finds it the most economical for conditions in that state. Bids for work have run as low as $1.33 per ton for the material complete in place on the road, exclusive of the oil, which is paid for separately, but including screening, crushing oversize, drying, mixing, hauling, spreading and maintaining, with the average haul about six miles. In California, where provision is not generally made for drying the aggregate, costs may be even lower. In a job at Rochester, Mich., (See PUBLIC WORKS, Jan. 1932), the cost averaged $4,000 per mile for 2½-inch pavement 20 feet wide, using gravel aggregate. Though this material was laid hot, the essential practices were the same.

Plant-mix is essentially the same as mixed-in-place construction, except that in the former mixing is accomplished at a central plant instead of on the road surface. Plant-mix, therefore, generally involves hauling aggregates to the machine (unless this is set up at a gravel pit or quarry) and thence to the road. Where there is not enough material in an old road to allow for scarifying and use of the road-mix method, the hauling will be necessary anyway; and plant-mix has certain additional advantages, such as a better control of the mixture and a greater freedom from interference by weather conditions. Also, special machines have been developed recently which are in effect traveling central mixing plants, thus avoiding hauling except that necessary to bring in needed new materials.

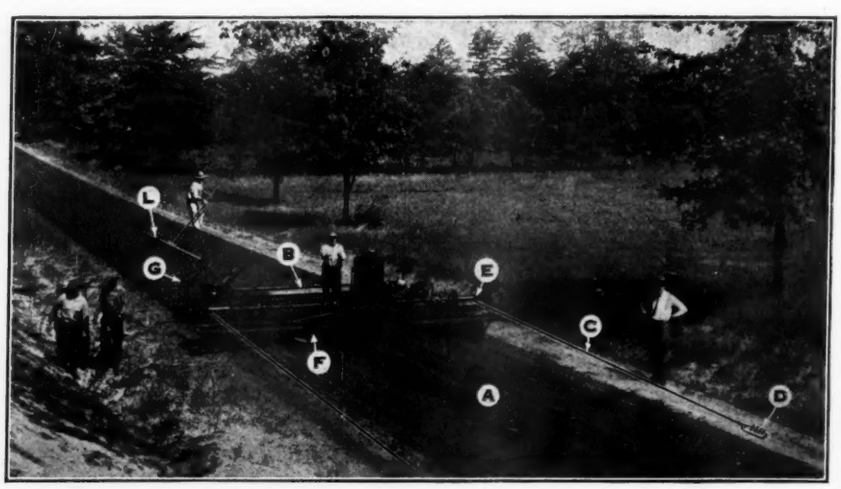


FIG. 3—*The Heltzel Spreader and Surfacer. The letters refer to operation phases*

In plant-mix, as in road-mix, crushed stone, gravel and slag are used as aggregates, and asphalts, tars and emulsions as binders. Though the aggregate should be free from dust and dirt, local materials can generally be used. For instance, S. E. Fitch, superintendent of highways, Chautauqua County,

N. Y., says: "I have used run-of-bank gravel of rather poor class, and with a large variation in sieve analysis. I have used run-of-crusher stone, soft and sandy, and also crushed hardheads and clean, hard limestone, ⅜ to 1½-inch. I have also used crushed slag of the same size, and with all these have used asphalts and tars of various consistencies, and all with good results. For most work, we use a tar of a viscosity of 74 at 40°C."

On a job in DuPage County, Ill., Edgar Otto, contractor, used tar with a viscosity of 65 to 85 at 40°C, and stone graded from 1½-inch to 1¾-inch for the base course, with approximately 8.5 gallons of tar for each batch of 2100 pounds of stone; and for the top course, 12.5 gallons of tar with 2100 pounds of ½-inch stone chips. The road surface was previously primed with 0.4 gallon of 25 to 35 viscosity tar.

The Asphalt Institute, which is about to issue a complete bulletin on plant-mixes, recommends an asphalt cut-back similar to No. 4 for aggregates containing material including dust, and a cut-back similar to No. 7 for the open or macadam type aggregates

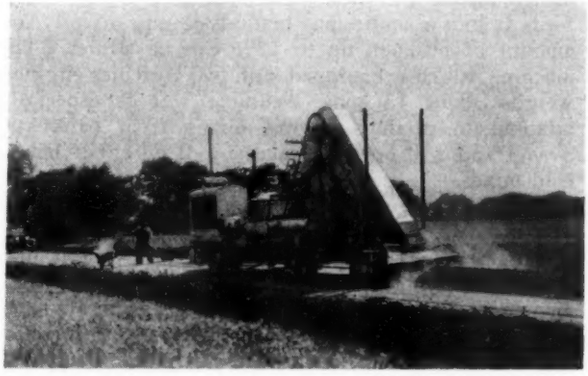


FIG. 5—*The Cedar Rapids Road Mix Machine*

Standard Oil Co. of Indiana manufacture a Cold Mix cut-back, which they recommend for use at the ratio of about 1 gallon per 100 pounds of stone, the size and grading of which depends upon the thickness of the wearing surface. Shell Eastern Petroleum Products recommends Colas Premix with 2 to ½-inch stone for the bottom course and ½ to ¼-inch stone for the top course.

It is in the west, however, that greatest attention has been paid to the proportioning of mixes and to the determination of aggregate sizes. In North Dakota, crushed rock or gravel suitable for crushing not being available in most sections, the fine graded type has been laid. Considerable emphasis is placed on proper grading; in fact, proper grading of aggregates

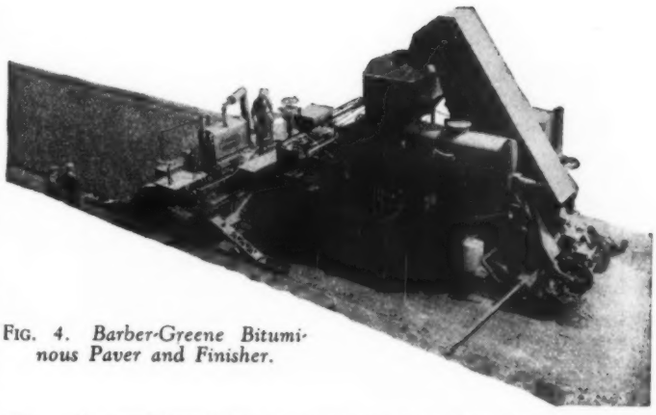


FIG. 4. *Barber-Greene Bituminous Paver and Finisher.*

is considered just as important in bituminous paving as in concrete construction. Herewith are shown curves (Figs. 1 and 2) sent us by J. N. Roherty, research engineer of the North Dakota highways department. These curves were originally developed in California. For an oil of about 300 viscosity (Saybolt-Furol at 122F), and a non-absorptive aggregate, curves 6 and 7 fit North Dakota conditions. For a 1200 viscosity oil and a non-absorptive aggregate, curve 9 fits; and for absorptive aggregate, curve 10 or 11. The curves are for round particles and allowance for shape is made when the laboratory gives the construction engineer the data on the curve to be used.

Plant-mix material, hauled to the road by motor truck, may be spread by hand, by blade graders of the type commonly used by highway departments for maintenance work, or by mechanical spreading and screening equipment, like that shown in Fig. 3, which illustrates equipment recently developed by the Heltzel Steel Form and Iron Co., Warren, O.

Equipment for Mixing

Three types of mixing apparatus have been used with satisfaction in cold-mix work—the bituminous pavers, the premix or bituminous mixing plants and concrete mixers. The bituminous pavers, as exempli-

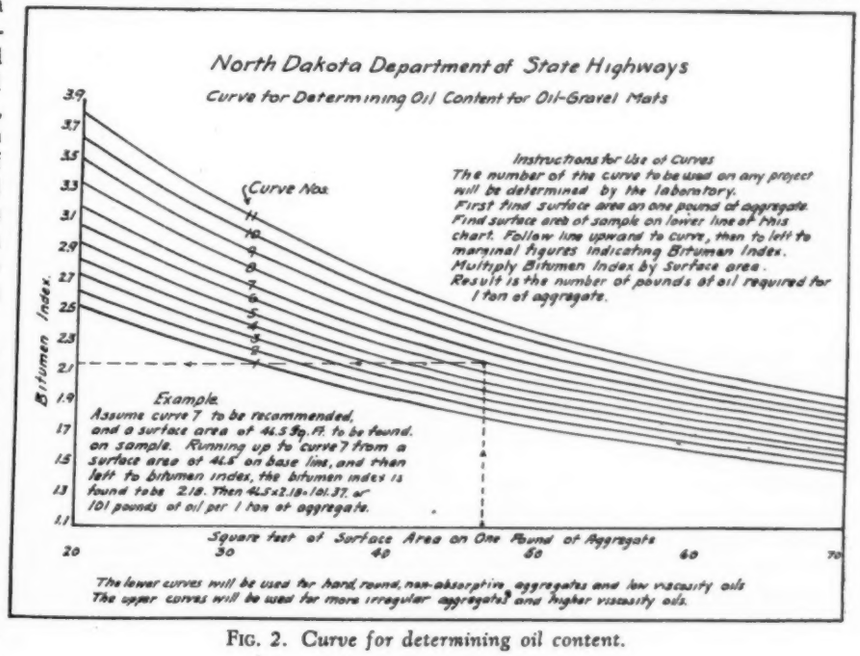


FIG. 2. *Curve for determining oil content.*

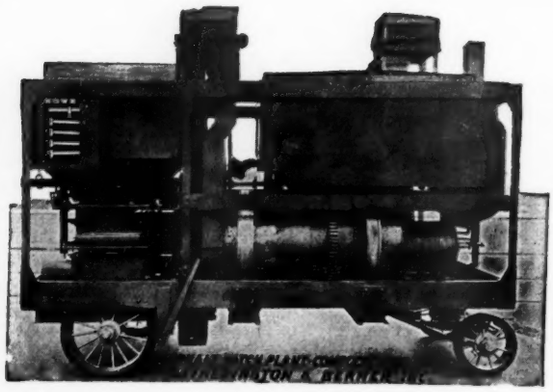


FIG. 6—*Hetherington & Berner one-unit patch plant*

fied by the Barber-Greene machine announced last year, are of special interest.

The Barber-Greene paver, Fig. 4, is a three-unit machine which provides a continuous system of mixing, laying, spreading and tamping in one operation and without the use of forms. One mile of pavement per day can be laid. The machine consists of three primary units, the loader, the mixer and the spreader-tamper, or finisher. The loader and mixer together are referred to as the paver. The paver and the finisher can be used independently, and the loader has a number of other applications, as when detached it can grade, do light excavating, load excess dirt, etc.

When operating as a paver and finisher, the aggregate is placed in a windrow in the center of the road. The loader picks up the windrowed material which is measured, mixed with bitumen and carried to the finishing hopper.

From the hopper, the bituminous material is spread by two horizontal screws, each covering half the road. Immediately to the rear is the tamper and just behind the tamper is the screed. The thickness, crown or super-elevation may be adjusted at will, giving a thickness up to 6 inches at the desired crown.

By means of the tamper, a thoroughly compacted surface is obtained and by the operation of the screed, isolated from road irregularities through the evener arms, a smooth-riding surface is assured.

This machine will operate at the rate of 1 mile of finished pavement per day, or about 11 feet per minute. Improvements and changes planned for 1933, and soon to be announced, should make this machine even more widely useful and applicable.

Mixing Plants

A number of plants are available for plant-mix work. Among them are the Cedar Rapids, the Chausse, the K. R., the PreCote, and the Saturmix. In addition are the standard asphalt plant type machines, such as the Simplicity, the Hetherington and Berner, the Cummer, and others, most of which can be used for this type of work. Some of these will be described briefly.

Hetherington & Berner, Inc., Indianapolis, Ind., have developed a portable automatic asphalt patch plant, Fig. 6, which has a capacity up to 400 yards per day. It will mix black base, binder or top material and can also be used for cold mix. It operates with fuel oil.

The Cedar apids plant shown in Fig. 5 is a bituminous road mix machine, owned by the San-Ore Construction Co., McPherson, Kans. The photograph shows the plant operating on part of a 40-mile contract just north of McPherson, the project involved using part of the old aggregate already on the road, and adding new aggregate to bring the total up to approximately 550 cubic yards per mile. The bitumen was an asphaltic base oil. This was hauled to the machine in tanks and the temperature maintained by a heating arrangement in the plant storage tank. The bid price of the contractor was approximately $2,000 per mile.

The Iowa Mfg. Co., who make the Cedar Rapids plant, also make stationary plants, a number of which have been used very successfully on both cold and hot-mix.

The Chausse unit is a complete asphalt plant, built in two units, both of which are mounted on rubber tired steel wheels, making them readily portable. One unit is the drier, equipped with oil burners, through which aggregate is fed. This, thoroughly dried and heated to 300°, is discharged into an elevator, which feeds it into a continuous blade-type pug mixer. Any amount of bitumen up to 12% can be added. The machine, which is equipped with two Hercules engines, weighs about 13 tons, complete. It is especially adapted to produce paving mixes from bank run gravel and will operate equally well on either hot or cold mixes.

The special feature of the Saturmix plant is the provision of a means of immersing the aggregate in a bath of asphalt emulsion and withdrawing it in a thoroughly coated condition ready for use. In brief, this process consists of supplying the aggregate to an immersion tank containing asphalt emulsion, in which tank is suspended a perforated basket so arranged as to be removed slowly, permitting drainage of the excess binding material. The perforated basket delivers the coated aggregate to a storage bin, from which point it is available for delivery to trucks reasonably dry, but thoroughly coated.

This process involves a minimum of labor, and it is possible to put material through the Saturmix machine practically as fast as it can be unloaded, and with the necessity of only one extra man, who is required to operate the machine. The capacity of the plant is 500 tons a day. Because of its portability, it is possible to change the setup as often as may be desirable, thus minimizing hauling distances, and making it profitable to undertake small yardage contracts.

Other Equipment for Mixing

Ordinary concrete mixers are entirely suitable for cold-mix work. The Smith tilting drum concrete mixer is reported as satisfactory and economical up to about 200 tons per day. Edgar Otto, the contractor, mentioned previously, used an old concrete paving mixer on the Hinsdale-Elmhurst job. The tar was heated in a tank car and pumped into a 30-gallon drum above the mixer. A wooden float in the drum gave the proper quantity for each batch. The Rex Moto-Mixers, developed for concrete work, have proved very well adapted to this work. These machines will mix and deliver any type of mixture, and are especially well adapted to widening work employing bituminous mixtures.

THE EDITOR'S PAGE

A Danger to the Road Building Industry

The legislatures of some forty-three states meet during the coming year, and there is much reason to fear that, in many of these states, further attempts will be made to divert gas tax and other purely highway funds to purposes other than highway building and maintenance.

An increasingly substantial portion of the funds necessary to construct our highways and to protect the investment in our present system of roads is derived from the gasoline tax. It has been, in the past, a tax rather cheerfully paid, principally because the taxpayer could see and enjoy the fruits of his taxes. He did not object to paying a 10% or even a 20% tax on the gasoline he used, so long as this tax provided him with smooth and easy miles of pleasurable travel.

Diversion of the gasoline tax is usually accompanied by an increase in the rate of taxation; and experience in several states has shown that an undue increase in the rate results in a diminution in the return to the state, partly through evasion and gasoline bootlegging, and partly through less usage. Whatever the excuse, or the method adopted, diversion of gasoline tax by legislatures should be resisted firmly, and if necessary belligerently, by everyone interested in maintaining and extending our present system of highways.

A Transition Stage in Sewage Treatment

Eighty-six years ago an Englishman named Higgs took out a patent for treating sewage by precipitating it with lime and applying chlorine gas to the sewage gases evolved. During the next twenty years seventy more patents were granted for treating sewage with various chemicals. In 1868 was patented the A B C process, so called because, of the ten materials combined in the dosing compound, the three first named were alum, blood and clay, the blood constituting less than 0.04 of one percent. This process was promoted so successfully that 190 more sewage treatment patents were issued in the next ten years, and more than 200 in the following ten. Most of the processes patented were chemical in nature although a few were not. (One provided for freezing all the sewage, and thus excluding the suspended matter.)

Most of these treatments were absurdities, but practice in England finally settled down to lime precipitation as the chief method, and this was the only one to be used at all extensively in this country. By 1900, chiefly because of the experiments conducted by the Massachusetts State Board of Health, biological treatment had supplanted chemical for new projects. However, chemicals have been used to supplement or aid other treatments, as for maintaining the pH most favorable for digestion, and in a few cases as the chief or only treatment, as in the Miles acid treatment. Recently the biological methods have given way here and there to purely physical treatments, and there are indications that new chemical treatments, or old ones used with a more complete scientific knowledge of the principles involved, may prove advantageous in some, perhaps many, cases. One such is described on page 11 of this issue.

Amid all the claims and counter claims for superiority advanced in behalf of the various methods, new and old, engineers must use common sense in judging the relative merits. There is probably no one name which covers a wider diversity of matters than "sewage." And it stands to reason that there is probably no one method of treatment which will be the best for every variety of sewage. In some cases biological, in others chemical, and in still others purely physical methods may be best; while in many the greatest success will be had with a combination of two or all three. The most successful sewerage engineers will be those who keep themselves informed of the real merits of the various new methods and under what conditions each is to be preferred to the others.

Meantime, during the transition stage of the next few years, it behooves city officials and engineers who do not keep themselves thoroughly informed to be cautious about accepting the claims of new ideas which we may be sure will be brought forward in great numbers. So far those that have been proposed have been founded on sound scientific principles and wisely conducted experiments, but there are indications that many impracticable, foolish or at best half-digested ideas will soon be brought forward and urged upon municipalities. It is more important now than ever that a city, before adopting any plan of sewage treatment, new or old, consult an engineer who devotes his life to keeping himself informed on these matters and is mentally and otherwise fitted to make wise decisions in selecting those best suited to each case.

A More Complete Service for Depressed Engineers

Elsewhere in this issue, in accordance with our usual custom, appears a small section devoted to the useless and the impractical; but useless and impractical as they are, these "Brainteasers" have found a very wide favor among our readers. We sincerely hope that the many hundreds who take the trouble regularly to solve them find in them some modicum of pleasure and of relief from the gloomy problems of the day. Certainly, they appear to find a real delight in unraveling the worst tangles that our figure-juggling Mr. Eisner can produce. He, by the way, has promised for the next issue a little Christmas present of a problem that will require some right smart jousting, a fitting one to end the year with.

But it is not our purpose here to make promises of future performance. Rather it is to call attention to our special service for depressed engineers, so that they may shed that dark and gloomy mien and walk among their fellow men models of cheer and happiness and freed from worry. If you do not find on page 7 matter to drive away the devils of gloom, take full advantage of our latest service, which you will find mentioned on page 59 of this issue.

Practical Details of Concrete Construction

By William E. Barker
Highway Engineer, Portland Cement Association

VI—Placing, Spacing and Tying Reinforcement

REINFORCING steel must be so placed in the concrete that it is protected by a sufficient layer of sound concrete against exposure to the weather or fire, that sufficient bond is provided between the two materials to make them act as a unit in accordance with the design assumptions, and that the reinforcement is convenient to place and support in the correct position without interfering with the placing of the surrounding concrete.

Footings and Walls

The simplest type of footing, the spread footing, is reinforced in the bottom with bars in two directions, perpendicular to each other. In this case, as well as in all cases in which the concrete is placed directly against the ground, a clear distance of 3 inches should be maintained between the reinforcement nearest the ground and the ground itself. This clearance may be provided by blocks of concrete, stone or brick of the proper thickness, upon which the reinforcement rests. If the concrete in footings and walls is exposed to the weather or ground, but placed in forms, a 2-inch covering is considered sufficient.

Footings supporting more than one column, combined or continuous footings, usually require main reinforcement near the top and bottom faces of the concrete. Reinforcement perpendicular to the main reinforcement may or may not be required for strength, but some cross-wise bars should always be provided for tying and placing. The necessity of providing a nominal amount of tying bars applies to slabs and walls in general. In slabs with top reinforcement, as in most combined footings, the bars in the top layer should be spaced not closer than 8 inches in order to permit spading of the concrtee below. The top bars are to be tied together and supported on stakes driven into the ground.

The following general rules govern the spacing of bars in the bottom layer in slabs and footings: The minimum center to center distance between parallel bars should be 2½ times the diameter, for round bars, or 3 times the side dimension, for square bars. In no cases should the spacing be less than 1⅓ times the maximum size of the coarse aggregate.

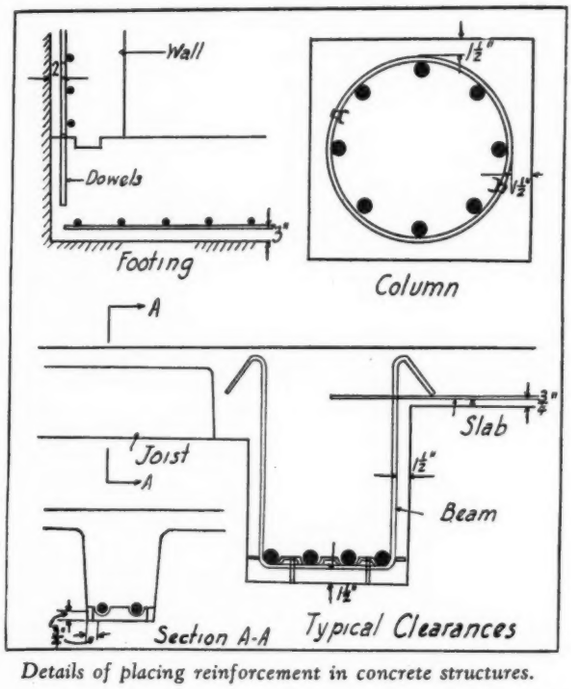
Vertical reinforcing bars in columns stopping at the top of footings, pedestals or walls are usually spliced by dowels, half the length of which extend into the concrete below the bottom of the column. Dowels can be placed by forcing them into the fresh concrete, but if reasonably accurate placing is required, it is preferable to hold the dowels in their correct relative position with ties, and then place and support them before casting the concrete around them.

Columns

The reinforcement in the most common type of concrete columns consists of a number of vertical bars placed equidistantly against the inside of a "spiral." The pitch or distance between successive turns of the spiral is maintained by spacers attached in the fabricating shop. In the field, at least four of the longitudinal bars are to be tied to the inside of the spiral before it is lowered into the column form, and the remainder of the bars required are subsequently lowered into place and tied to the spiral. A clearance of at least 1½ inches is usually specified between the outside of the spiral and the form. For columns exposed to the weather, this clearance must be increased to 2 inches or more. An accurate centering of the column reinforcement has in some instances been obtained by means of concrete rings shaped as "doughnuts," with the bars sticking through the hole in the ring.

Beams

The reinforcement in a typical beam consists of longitudinal (straight and bent-up) bars in one or more layers and a series of stirrups. The clearance between the stirrups and the forms should not be less than 1½ inches for inside or protected structures nor less than 2 inches for exposed structures. The stirrups are placed first in their relative position and tied together with tie wire, the ends of which are nailed to the forms. The longitudinal bars are then lowered into the form-box and placed upon metal supporters resting upon the bottom of the form. Two types of supporting devices are used, the beam bolster with a straight top rod upon which the beam bars are laid, and beam chairs with a pocket for each supported bar. The beam bars that are bent up near the quarter-point and extended near the top of the beam into the adjacent span should be held securely in place so that they will not sag below their theoretical position. The stirrups should now be pulled up to bear on the underside of the longitudinal bars and tied to them. The tying of the stirrups is often omitted, and the stirrups are pulled up after the bottom of the beam form has been filled with concrete. Since the latter procedure fails to furnish a reliable support for the stirrups, it is preferable to use stirrups which are assembled in the shop and provided with legs that rest on the bottom of the form and maintain the required clearance.



Details of placing reinforcement in concrete structures.

A clearance of ¾ inch is considered sufficient for joists, small beams spaced about two feet apart. The longitudinal bars in joists are supported upon joist chairs, and stirrups are seldom required.

If there is more than one layer of longitudinal bars in a beam or joist, upper chairs or bolsters are used between the layers.

Slabs

In solid one-way and two-way slabs in inside or protected work, a minimum of ¾-inch clearance is required. This clearance is controlled by the use of slab spacers. Slab spacers may be either plain rods welded to metal feet, or they may be fabricated with tie wire attached to the spacer rod at distances corresponding to the spacings required for the slab bars. Slab spacers with attached tie wire but without supporting legs are also fabricated. Slab spacers should be spaced not more than 7 feet apart.

Top bars or bent-up bars, as used in flat slab construction, rest on supporting bars held at the proper elevation by high-chairs of metal.

Local design specifications should be carefully inspected for requirements as to the spacings and clearances, as these may vary slightly. The requirements should be incorporated in the general notes or typical sketches shown on the drawings.

R. F. C. Funds for Sewerage

IN the case of a sanitary sewer system it may be said that practically all of the service rendered is to private individuals as such, and that therefore it would be logical to finance both the construction and operation by means of direct payments made by the users—making them self-liquidating by means other than by taxation. That would make them eligible for loans from the R. F. C.

Sewer rentals for sewer service seem to some to be so unusual as to be almost bizarre; and yet 107 cities in 18 states make such charges, according to a report of the American Society of Municipal Engineers, and in 3 other states enabling acts are in operation. Of these cities, 46 are in Texas, 19 in Ohio, 9 in New Jersey, 6 in Massachusetts, 5 in North Carolina, 5 in Virginia, 3 in Pennsylvania, 2 in each of the states Alabama, Mississippi and New Mexico, and 1 in Arkansas, Connecticut, Kansas, Maryland, Michigan, Missouri, New York and Oklahoma. Indiana, Iowa and Oklahoma are the three with unavailed-of enabling laws.

Of these, 55 charge a uniform price for each connection; 25 base the charge on the number of fixtures; 17 on the amount of the water bill; 2 by the front foot; and 8 did not report. Most of the flat rates lie between $6 and $24 a year for residences; those based on water rates, between 10% and 100% of the water bill.

According to this report:

"Any equitable plan by which funds can be obtained continuously for sewerage operation and maintenance without depending on appropriation from the tax levy will have the following distinct advantages:

"Funds can be provided continuously and adequately to insure efficient operation and the service.

"The source of revenue will not be in direct competition with other more popular budget items in the tax levy.

"The funds will not be subject to economy cuts at the whims of disinterested officials.

"Each property owner will pay only his fair share of the cost in accordance with his use of the system. Taxpayers having no sewerage facilities will not be required to pay for maintaining the service rendered others.

"The sewerage system and especially the sewage treatment plant, if any, can be maintained in an efficient condition and thereby avoid waste of public property.

"The danger of lawsuits because of pollution from the discharge of untreated sewage or other nuisances will be avoided if the sewage treatment plant can be kept in good condition.

"The availability of funds will permit engaging trained operators and adequate labor, and will make possible the operation of the sewerage system as a self-supporting public utility comparable with the water supply system.

"The funds can be limited in use to the purposes intended which, as a New York law puts it, are the 'payment of the cost of the management, maintenance, operation and repair of the sewerage system, including treatment and disposal works.'

"While there may be ample justification in the theory of obtaining funds from the tax levy for these purposes, *the facts remain that many sewerage systems have suffered seriously and sewage treatment plants have been ruined for lack of funds, whereas these troubles might have been avoided if an annual service charge plan had been put in operation.*"

Experiences With Pneumatic Tires for Tractors

The use of pneumatic tires for certain types of tractors is stated to have a number of advantages. To determine what the experience had been in this field, PUBLIC WORKS asked a number of county highway engineers and road officials. A sufficient number of replies have been received to indicate clearly that the general experience is that tractors equipped with such tires can do more work and suffer less wear.

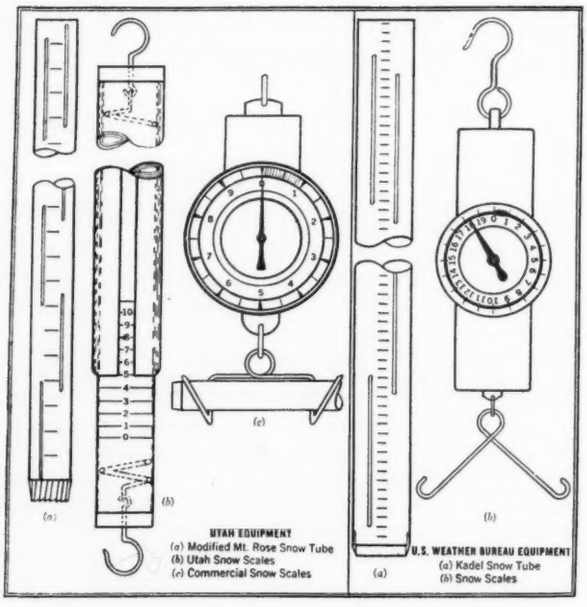
So far, replies have been received from engineers or officials representing 677 counties in all parts of the United States. Of this number, 80 did not reply to the question, 484 reported that they had had no experience with this type of equipment, and 113 reported that they had used pneumatic tires for tractors. The experiences of these 113 is of special interest as showing almost universal satisfaction.

Of the 99 answering the question: "Have you found them to be cheaper in cost per mile?", 85 answered affirmatively, 8 negatively and 6 were doubtful. Of 102 replying to the question: "Do they increase the amount of work a tractor can do?", 97 said "Yes," 4 "No" and 1 was doubtful. The question: "Do they reduce wear and tear on the tractor?" was answered as follows: Yes, 102; No, 1; ?, 3.

In answer to the question as to the kind of work to which pneumatic tires were found to be most particularly adapted, there were 112 replies. Of these, 99 mentioned maintenance; 5, mowing; 1 each construction, snow removal, hauling material, and pulling heavy trailers; and 4 believed them best for all work.

S. E. Fitch, County Superintendent of Highways, Chautauqua County, N. Y., writes as follows: This county last year had eleven one-man graders on crawlers, three of which had about worn out the tracks. The manufacturer had designed a set of tandem dual wheels to replace the tracks without alteration other than the addition of the new wheels. The cost of the change was about the same as a new set of tracks, so one tractor was changed over to pneumatic tires, 2 in front and 8 in the rear. After using this machine for a while on various kinds of work, the other two which had worn-out tracks were equipped the same way, and as fast as the tracks wear out we will do the same with the others.

Pneumatic tires do not have quite the traction under some conditions that crawler tracks do, but are much speedier and more efficient in other ways. They operate quietly, and we do not load them on a truck to transport them from one part of the county to another, since they will make almost as fast time on their own power as a truck will. All in all, we think they are far ahead of crawlers.



Types of snow samplers and scales used in Utah

THE WATER WHEEL

Following are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.

SNOW SURVEYING again this month is the subject of an interesting article. In "Forecasting Water Supply"[7], an irrigation engineer of the Utah Agricultural Experiment Station describes in detail how snow surveys are made in that state, and their importance. "It is estimated that from 60 to 90 percent of the total annual precipitation on the high watersheds in Utah falls as snow and accumulates throughout the winter, forming the storage supply from which water is drawn in the summer." By measuring the snow cover for a number of years and plotting the data so obtained against the run-off (which is measured), the basic relations between snow cover and run-off are determined; although the relationship is affected by other conditions, which vary with different watersheds and more or less from season to season, and the relationship must be determined for each watershed separately. The longer the record the more accurate the determination of this relationship. A six-year record of the Logan watershed apparently makes it possible to predict to within 10 percent the run-off between July and September, when the snow from high altitudes is the principal source of supply.

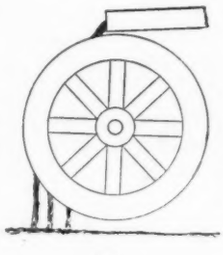
RFC Loans—So much interest is felt in the RFC loans for water works and other municipal "self-liquidating" projects that one issue of Engineering News-Record is largely devoted to that subject. Malcolm Pirnie[9] sees the act as stimulating, or rather requiring, that water works management, financing and accounting be put on a self-contained basis, and as a good thing for the water works business. E. B. Black, however, calls attention to features so objectionable as to place the loan beyond the reach of many if not most companies and departments[13]. To comply with the act, charters or state laws, or at least the entire rate structure, must be changed; which can not be effected in the few weeks during which the application must be made if it is to be effective of its purpose—relieving unemployment this winter and spring.

Dams, although among the oldest engineering structures, still offer many opportunities for investigation of laws and physical properties involved. Thermometers buried in the masonry of a concrete dam[16] showed a rise of temperature of 23° during the setting of cement, and on returning to normal the concrete contracted, which opened the contraction joints and caused seepage. This was reduced from 2.8 sec. ft. to 0.85 sec. ft. by injecting grout under pressures up to 120 pounds.

Hydraulic-fill dams are the subject of two important discussions this month, one on drainage of beaches[18] and the other describing tests made on the Cobble Mountain dam[28]. The Alexander dam in Hawaii was being constructed with careful attention to core material and little to beach material, when the latter slid foreward, but most of the core remained standing. This was in 1930. In 1931 construction was renewed, but drains were imbedded in the beach to keep it from becoming saturated with water from the core pool, and the dam was successfully carried to the contemplated height, a maximum of 140 feet.

Mr. Hatch's paper of several hundred pages, condensed to 42 pages of the "Proceedings," is an exhaustive discussion of tests conducted in the laboratory of the Cobble Mountain dam on core materials of hydraulic-fill dams, and the derivation of seepage and other formulas therefrom. The ultimate aim of the author is the standardizing of methods of testing such materials. "After all," says he, "the requirements of the core and beaches of a hydraulic-fill dam are the same for any dam and at almost any location."

Linings for cast-iron pipe are discussed in a paper[26] by the vice-president and engineer of the U. S. Pipe & Foundry Company, which has tested most of the materials proposed. The chief objection to portland cement lining was the hardness contributed to the water, about half of which is due to free lime (using ordinary cement) and half to alkalies and aluminum compounds. The smoother the surface, the harder the water when the lining is first used. Cement



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linings are apt to check or pull loose when the pipe is exposed to sun or other heat; but one covered with white wash has been found to remain at 30° lower temperature than one not so covered, when they were exposed to the sun. The writers expect to see cement linings improved to be the most satisfactory ones, at least under certain conditions. Coating the cement with a bitumen is not favored. Bitumastic linings (a pitch base with mineral filler) are smooth and dense, but either are brittle and crack in cold weather or become soft and flow when warm. After being placed in service, these temperature extremes do not occur. As to the smoothness, E. T. Killam[27] reports that carefully conducted tests on a line of mains more than three miles long showed a coefficient C=150, using the Williams-Hazen formula. Experiments are being conducted with addition of a plasticizing agent to pitch to eliminate the disadvantages just referred to. Vitreous enamels "have a very smooth and glossy surface with a resulting . . . high carrying capacity. Furthermore, the lining is very thin and the effective diameter of the pipe is not materially reduced by its application"; but "we are not prepared to say at the present time that they will entirely prevent tuberculation."

Deep-well turbine pumps have been built for depths as great as 825 feet and capacities as high as 10,000 g.p.m., says David J. Conant[19]. "The efficiency of the multi-stage well turbine in capacities under one thousand gallons per minute and under moderate heads can equal or exceed that available in standard horizontal pumps." Three types are in use, classified as impulse, reaction, and mixed flow or "K" type. There are relatively few impulse type deep-well pumps on the market; this type "is best suited for high head per stage and relatively small capacity." The reaction type is best suited to medium capacity demand. For high capacities from relatively small wells, with low head, "the screw or propeller pump dominates the field," but the K type pump approaches the capacity of a screw pump with a practically constant power curve from closed gate to wide open. "In wells of high capacity where levels vary between wide limits, the ideal type is the "K" pump."

A dry hypochlorite product, non-hygroscopic, stable and easily soluble "has not proved a competitor of liquid chlorine, but rather a companion product desirable for the particular uses in which it proves to be the cheapest or most convenient source of available chlorine" says J. A. Kienle[39]. Such uses reported by fifty users included chlorination of pipe lines following construction or repair (more than 50%); keeping on hand for emergencies, such as use of doubtful water during droughts or accident to regular supply, infrequent pollution of supply; where money is not available to purchase chlorinators; sterilizing new wells before use; one-third used it for sterilizing and cleansing rapid sand filters; control of algae and bacterial after growths in storage reservoirs; only small plants (10% of replies) used it for regular continuous chlorination.

Activated carbon has been used at New Castle, Pa., since December, 1930, and city chemist B. F. Johnson has given much valuable information concerning their experiences[55]. "As a new agent in the treatment of water, activated carbon has met with the minimum of objection (except on the part of those who actually handle the 'black stuff'—the solution here may be the employment of colored help). The less we can depend on chemical action of soluble agents and the more we can depend on mechanical and physical action, the more palatable the water becomes." It was found that application of the carbon to the settled water removed tastes and odors with about one-third the dose required if applied to unsettled water—an average of 0.2 g.p.g. as compared to 0.8. The former had no effect in clogging filter beds. Best results require thorough mixing of carbon with the water, sufficient contact period before filtration, and application at the proper point. It tends to decrease chlorine demand; "to maintain the same chlorine residual this spring, after stopping the use of carbon for several weeks, required a 30% increase in the chlorine dose."

Emphasis was placed on the value of a taste and odor test made by distilling and collecting about 100 cc. from a 500 or 600 cc. sample. "The distillate will contain practically all the taste and odor present, if any, in the original sample," but several times as strong and therefore more easily and definitely identified. The test is used as a control in the use of activated carbon. Mr. Johnson describes in detail how to make it.

Fire hydrants are classified by an elaborate color scheme in Reading, Pa.[65], red for pressures above 100 lbs.; aluminum for pressures from 50 to 100 lbs.; yellow for pressures below 50 lbs.; and blue for separate hydrants used for street flushing. Presumably there are no color blind employees in the water and fire departments there.

Leakage surveys at Reading have reduced unnaccounted-for water from 48 percent in 1926 to 24 percent in 1931[65]; the actual amount of unaccounted-for water having been reduced 68 percent. Two leak patrolmen cover the 160 miles of distribution system every three weeks.

Mud balls in rapid sand filters are, according to Edward S. Hopkins[63], "caused by the compacting of dirty sand grains into masses due to the improper washing of the beds. This is particularly true when fine sand is used as a filtering medium. Utilization of sand at least 0.5 mm. diameter, together with high velocity washing of the bed to give a 40-50% expansion, if practicable with existing plant design, will maintain clean beds free of mud deposits."

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c, indicates construction article; *n*, note or short article *t*, technical article.

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2. New Water Plant Built Around Old Units, pp. 56-61.
3. *n*. Pneumatic and Mechanical Handling of Water Works Chemicals. W. M. Wallace, pp. 76-77.

The Canadian Engineer, October 18.
4. Modern Rapid Sand Filtration Plant at St. Thomas, Ont. W. C. Miller, pp. 17-18, 33-34.
5. New Water Purification Plant Opened at Oshawa, Ontario, pp. 19-21, 37-38.
6. Advantages of Metering Water Services. E. H. Ruehl, pp. 22-24.

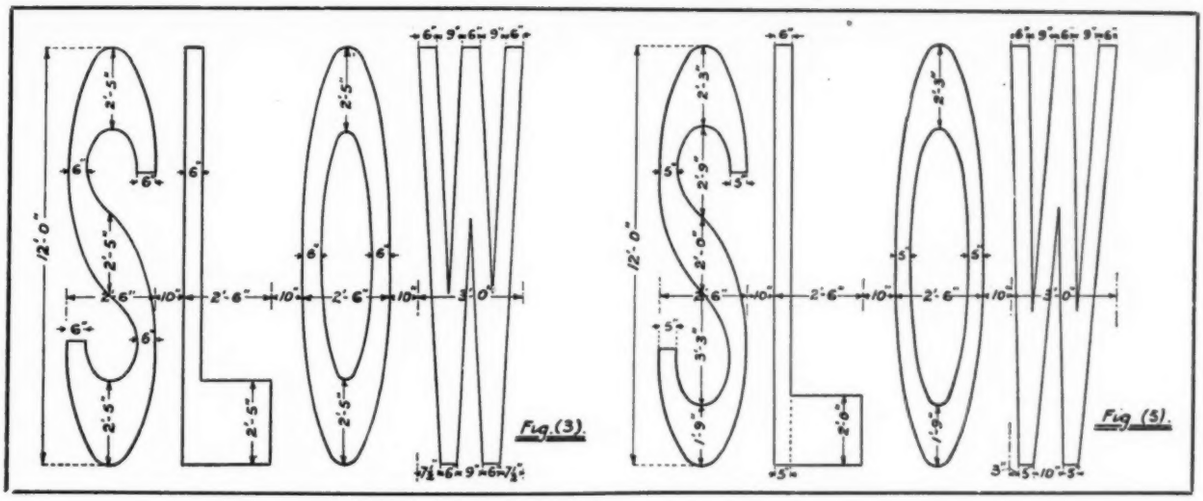
Civil Engineering, October.
7. Forecasting Water Supply. Geo. D. Clyde, pp. 610-614.
8. Erosion Below a South African Dam. Philip R. R. Bisschop, pp. 623-625.

Engineering News-Record, September 22.
9. Relief Act Encourages Revision in Waterworks Policy. Malcolm E. Pirnie, pp. 336-339.
10. Supply and Distribution Facilities Are Underdeveloped. G. Gale Dixon, pp. 339-341.
11. Safety and Quality of Water Still Need Improvement. F. H. Waring, pp. 341-343.
12. Waterworks Planning for New Conditions. Geo. W. Fuller, pp. 343-346.
13. Changes in Financing to Follow Relief Act. E. B. Black, pp. 346-347.
14. The Investor's View of Waterworks Bonds, pp. 347-348.

October 6
15. Regional Water Problems at N. E. W. W. A. Meeting, pp. 412-413.

October 13
16. *t*. Contraction Joints of Pardee Dam Grouted a Second Time. F. W. Hanna, p. 431.

(Continued on page 53)



Lettering on Road Surfaces

ADMONITORY words on street surfaces giving traffic directions have become universally common, in Europe as well as in America. The chief argument for them is that the driver of a car should keep his eyes on the road and not have to be continually watching the sides, and even the air above, for traffic signs.

But they have the serious objection that they can not be seen when less than 15 to 30 feet ahead of the car, while at a distance greater than this they have a foreshortened appearance due to the flat angle between the pavement and the line of sight. They should therefore be distorted to compensate for the foreshortening, and made large so as to be readable at a considerable distance. A study of the best form to be given letters used for this purpose has been made by H. C. Platts, an English engineer, and an article by him in the *The Surveyor* is abstracted below.

The width of the letter is determined primarily by the length of the word and the width of roadway on which it is to be placed. For example, if the word "SLOW" is to be placed in the half of a 30-foot roadway, the spacing would be as follows:

Three letters, "S," "L," and "O," at 2 ft. 6 in....	7 ft. 6 in.
Letter "W" (extra width)	3 ft. 0 in.
Intermediate spaces, 3 at 10 in.	2 ft. 6 in.
Marginal spaces, 2 at 12 in.	2 ft. 0 in.
Total....	15 ft. 0 in.

The maximum thickness of the lines of the letter is determined by "full" letters such as B, E and S. In E, for example, Fig. 1, the thickness t should not exceed one 5th the height, or a blurred effect would be given, and one 6th is preferable.

If we assume that a letter becomes legible when its apparent height, allowing for foreshortening, is 6 inches, then (see Fig. 2) $\frac{x}{y} = \frac{h}{l}$, whence $l = \frac{hy}{x}$.

If h, the height of the driver's eye above the pavement, be taken as 5 feet, then $l = 10\ y$, y being the height of the letter. That is, a letter becomes legible when distant from the driver ten times its height.

If we let L be the distance over which the car passes while the letter is fully visible, and 20 feet as the distance at which it is hidden by the front of the hood, then $L = l\text{-}y\text{-}20 = 9y\text{-}20$.

What L should be depends on the speed of the car and the period during which the word should be visible. If we take these at 30 miles an hour and 2 seconds, L = 88 feet, and y = 12 ft.

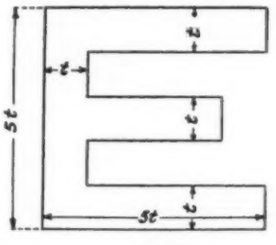


Fig. (1).

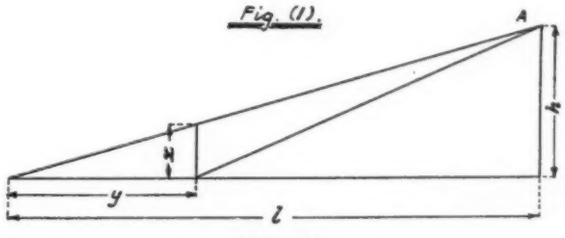


Fig. (2).

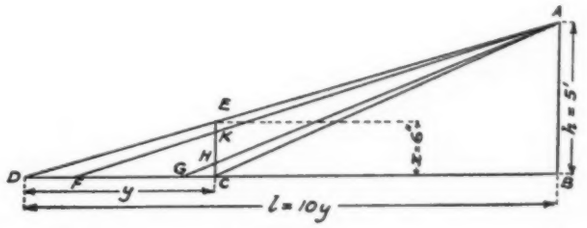
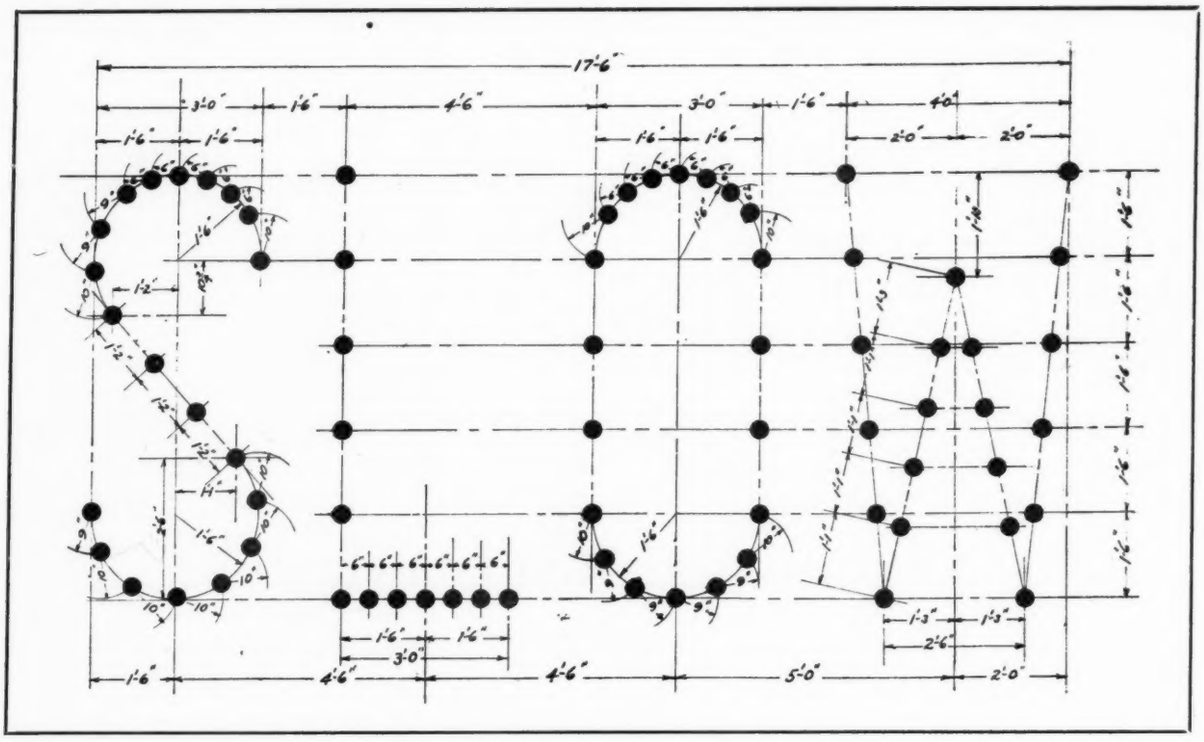


Fig. (4).



Spacing of traffic markers in forming letters on road surfaces.

Relative values for the several quantities are given in the following table:

Length of letter. "y" ft.	Distance at which letter becomes legible. "I" ft.	Distance over which letter is legible. "L" ft.	Period of time in seconds in which letter is legible completely, at speeds:— 20 m.p.h.	30 m.p.h.	40 m.p.h.
4	40	16	.55	.36	.27
6	60	34	1.16	.77	.58
8	80	52	1.77	1.18	.88
10	100	70	2.39	1.59	1.19
12	120	88	3.00	2.00	1.50
14	140	106	3.61	2.41	1.80

Given the length of the letter, the thickness of transverse parts may be taken as one fifth or one sixth of this. But, as shown in Fig. 4, the top of the letter is foreshortened more than the bottom. As it appears to the driver, E K is the thickness of the top line and H C that of the bottom. If these are equal and their average is one fifth y, then D F = 0.22 y and G C = 0.18 y, approximately. That is, the top thickness should be increased and the bottom thickness decreased by one-fiftieth of the length of the letter. For practical purposes the correction may be taken as ¼ inch per foot of length of letter. As an example, consider a letter with length of 12 ft. with thickness ratio of one-sixth. Then the mean thickness of transverse parts is one sixth of 12 or 2 ft.; correction of perspective is ¼ in. x 12=3 in., and thickness of transverse part at the top is 2 ft. 3 in. and at the bootom 1 ft. 9 in.

Fig. 3 shows letters based on a 1:5 ratio with uniform thickness top and bottom; Fig. 5 the same letters on a 1:6 ratio and with unequal thicknesses. In the latter, the base of the L is not reduced because it is an inconspicuous letter. The W is made not quite symmetrical if placed at the right end of a word on a left-hand curve, for if symmetrical it appears to lean to the left.

Placing Traffic Markers

The accompanying drawing shows a spacing of traffic markers for lettering stop and warning signs on pavements which the engineers of the Thompson Products Co. have found to be satisfactory. This layout gives a width of 17.5 feet for the "SLOW" and a height of 7.5 feet. For "STOP" a width of 16.5 feet is recommended, with the same height. The spacing between the markers varies with their position, as shown. On crosswalks, a spacing between markers of 15 to 18 inches is recommended; and on center lines, a spacing of 3 feet. The traffic markers made by this company, with high visibility because made of non-corrosive white metal aluminum alloy, are claimed to be suitable for use on asphalt, brick, concrete or stone block pavements. The recommended method of installation is as follows:

Asphalt.—Using an electric-driven twist drill or an air compressor star drill, drill an *undersize* hole 2½ inches into the pavement. The best diameter is ⅝-inch. Paint about the hole with a sizing compound, pour hot asphalt or tar into the hole, and drive the marker home with a wood mallet or sledge hammer.

Concrete or block pavements.—Using an air compressor driven star drill of 13/16 or ⅞-inch size, drill an *oversize* hole 2½ inches into the pavement. Paint about the hole with a sizing compound, and pour hot asphalt or tar into it. Quickly insert the marker and allow the bituminous material to harden.

The use of a sizing compound or of hot tar or asphalt is said not to be absolutely necessary, but to improve the bond between the marker and the pavement and also exclude moisture.

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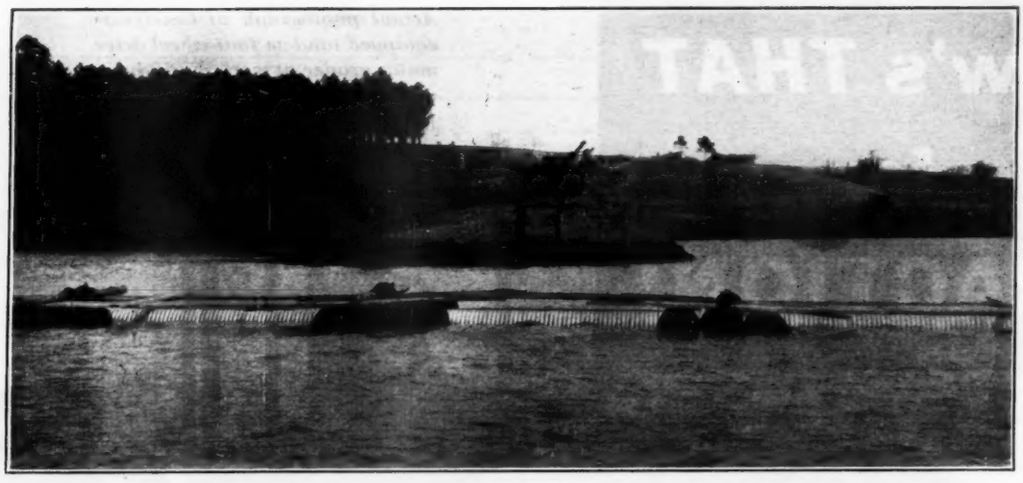


The Armco corrugated pipe in position in the gap in the highway ready to be lowered into position. Wires to shore made it easy to control the pipe.

Building Highway Across Reservoir Twenty-Three Feet Deep

By Vance Johnson
Project Engineer, Texas State Highway Dept.

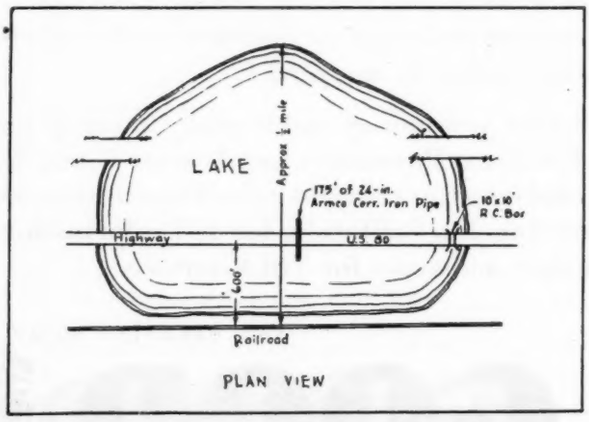
IN THE relocation of U. S. highway 80 near the town of Big Sandy, in east Texas, it was necessary to cross a reservoir serving as water supply for the two railroads passing through the town. A railroad embankment forms the dam of the reservoir which, at spillway elevation, is about one-half mile long.

The highway location is about 600 feet from the dam, and approximately parallel to it. The depth of the reservoir at the highway location is twenty-three feet below spillway elevation. The railroad company owning the reservoir insisted that connections under the highway should be provided so that, in case of extreme drouth, water could be pumped out of the entire reservoir to a depth of 13 feet below spillway elevation.

Embankment was used for most of the construction across the reservoir, and it was first proposed to use a pile trestle across the deepest part. The soil available for the fill consisted of light sand and clay and considerable argument arose over what the angle of repose for these materials would be under water. Opinions of various engineers and construction men ran all the way from 2 to 1 to 8 to 1. It was finally agreed that the dirt would come to rest on a 4 to 1 slope under water. (It is interesting to note that, on actual construction, these materials came to rest on about a two to one.) Assuming a 4 to 1 slope, the shortest length of bridge which would leave a channel of the required depth would have been considerably over a hundred feet. A quick estimate showed that an earth fill of the required height would cost only a fraction as much per linear foot as a concrete pile trestle of this length.

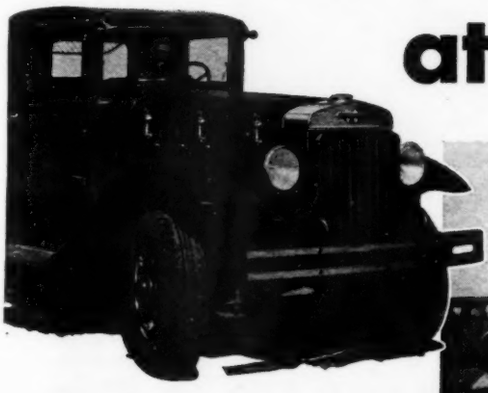
The drainage area was only a few hundred acres and finally the railroad company agreed to the construction of a 10 by 10 concrete box culvert on the shore line to handle flood water and serve as a boat pass, and the installation of a 24-inch pipe culvert in the middle of the lake with flow line 13 feet below spillway elevation.

Some of the engineers connected with the construction favored the use of cast-iron pipe for the smaller culvert, but the installation of 175 feet of heavy 24-inch cast-iron pipe in 20 feet of water immediately appeared to the men in the field to be a very uncertain and costly undertaking. Familiarity with advantages of corrugated metal pipe for such a situation as this enabled the contractor and the writer and others to convince the "opposition" that it would be more satisfactory for this situation, having fewer joints, lighter weight, and longitudinal flexibility or



Sketch of reservoir, showing location of highway

30 *More* Heavy-Duty Internationals Go to Work at Hoover Dam!



Above: The new heavy-duty International A-7 as sold for average hauling service. International sizes range from ¾-ton up.

Right: A new armored International Model A-7. This capacity load of wet gravel has come eight miles to Boulder City, the full distance in third gear, with atmospheric temperature 112°, engine heat indicator never over 190°.

ORIGINALLY purchased for the dry tunnel excavating at Hoover Dam, International Trucks performed with such outstanding success that when it came time for the dam proper, with its heavier mud and silt, 30 new Model A-7's were added for this heavier work.

When the work was first started, Six Companies Inc. chose International Trucks against the field. More and more units were put in service until the number of Internationals *more than doubled all other makes combined—outnumbering any other single make by more than four to one.*

The International fleet is supplying the most spectacular action in the blistering canyon and on the steep grades. The armored trucks have earned not only the admiration of every observer from driver to news cameraman but also the full confidence of the close-figuring contractors behind the scenes. *From the outset right down to date, International Trucks have handled the major part of this stupendous hauling contract.*

★ ★ ★

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As sections of pipe were added the pontoons were pushed out into the water until entire 175 feet was connected ready for final placement. Partly completed highway is seen in background.

"give" without danger of breakage on uneven bedding. All concerned finally agreed upon using No. 10 gauge pure iron corrugated metal pipe.

The method of installing the pipe finally adopted was a combination of ideas contributed by almost every man on the job, with honorable mention for Mr. Lucas, the contractor, Mr. Buckner, the sub-contractor, and John Fawks, foreman in charge. The method, which was perfectly successful, was as follows: Sixty-two empty oil drums, bought for 50 cents each, were used for making pontoons, each consisting of six drums, three lashed together on each side of the pipe, which was suspended by a sling from a pole resting with one end on each set of drums. The first section of pipe was rolled down until one end was in the water and this end was slung on one of the pontoons. Then the pipe was pushed into the water with the pontoon supporting the outer end, and another pontoon was secured to the middle of the section. The next section was coupled on, pushed out, and more pontoons put on, etc. The outer end of the pipe was held from drifting back into shore by a line of No. 9 wire to the opposite shore.

When the entire 175 feet of pipe had been floated on the pontoons in this manner, it was pulled into place, in the gap left in the fill across the lake, by lines to the shore and to the parts of the fill which had already been constructed. A number of rocks weighing up to 100 pounds each were then tied to the pipe, hanging about 2 feet below the bottom of the pipe, the idea being that they would become imbedded in the earth when the fill was being extended across the temporary gap and keep the pipe from being pushed upward by the mud as well as anchor it in position laterally.

To hold the pipe in position, a number of lines of No. 9 wire were used, with one end tied around the pipe at regular intervals and the other end tied back to anchors in the fill already made, some leading toward each side of the gap. The pipe was then lowered by loosening the slings on the pontoons about a foot at a time, until a leveling rod used from each pontoon showed that it had reached the desired depth. The earth fill was then extended across the gap.

The total labor cost, after having materials on the job, was slightly over $60.

The above is slightly condensed from "The Highway Magazine," to which we are indebted for the illustrations.

Cheap Bridge Models Valuable in Design

THE above model of a California bridge was made of plaster of paris and cardboard with a couple of small sponges to represent trees. Materials cost between $3 and $4, and the work required but a few days' time. F. W. Panhorst, acting bridge engineer, writing in *California Highways and Public Works,* points out the advantages in using such models, and says:

"This model is the first made by the department and was made primarily as an experiment to see if the time and effort were justified. We have found that time and money were well spent inasmuch as we have made a number of changes due to certain features appearing in the model which could not be visualized from the plan."

The model shown is built to a scale of 1 to 96.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 61

Resurfacing Old Pavements With Brick

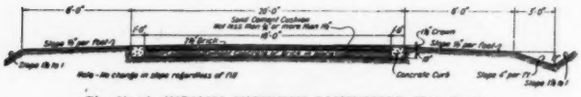


Fig. No. 1—INDIANA HIGHWAY COMMISSION (Standard)

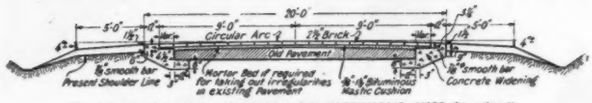
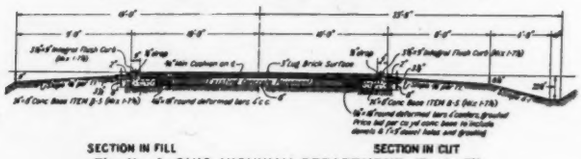
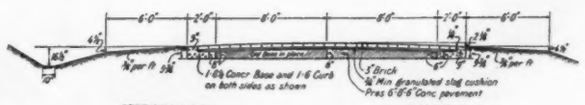


Fig. No. 3—ILLINOIS DIVISION OF HIGHWAYS (1932 Standard)



SECTION IN FILL SECTION IN CUT

Fig. No. 2—OHIO HIGHWAY DEPARTMENT (Route 73)



SECTION IN CUT SECTION IN FILL

Fig. No. 4—OHIO HIGHWAY DEPARTMENT (Route 3)

Standard designs of three states for resurfacing old pavements with brick.

The Illinois Division of Highways in 1932 has received bids for resurfacing over sixty miles of old concrete pavements with brick. Indiana is resurfacing with brick the concrete pavement on Route 41 south of Sullivan. Ohio, which began resurfacing with brick in 1921 and has used it on macadam, slag and gravel as well as concrete, is using brick this year for resurfacing eight miles of 3-C highway northeast of Mt. Vernon.

The details of such resurfacing differ in the different states. Resurfacing is almost invariably accompanied with widening. If the concrete is 18 feet wide, a 12-inch raised curb on each side will provide a header for the new brick surface and make the total new pavement width twenty feet. If the concrete is less than 18 feet, it is customary to extend the old slab with new concrete and construct a curb integral with the extension. In some cases the designing engineers have considered it desirable to provide a mechanical connection between the old slab and the new widening curb. Other engineers do not consider this a necessary or even desirable feature.

In the 1932 Illinois standard section (Fig. 3), the concrete widening extends integrally under the old slab for a width of 12″ and depth of 6″. Thus additional thickness is provided. In the design used on Ohio Route 73 (Fig. 2), ⅝″x18″ round deformed bars 4″ centers were inserted and grouted in the old slab. However, this was the only Ohio project on which this construction was used. In a later project (Fig. 4) dowel bars were not included. This is also true of the Indiana standard design (Fig. 1), where a 10″x12″ additional curb made a twenty-foot width overall. These designs (Figs. 1 and 4) are more economical and the sub-grade under the old slab is not disturbed. Ohio, which formerly made the curb 12 inches wide, has now adopted a 9-inch curb width. This increases the effective travelable width of the heavy-duty brick surface. In the typical cross-sections shown, there will also be noted a divergence of practice in bed course (or cushion) construction. Illinois has had notable success with bituminous mastic, and in sections where economically available Ohio favors granulated slag. The Indiana specifications call for a sand-cement cushion.

Marking Curves on Tar and Oil Surfaced Roads

Highway departments in the central west have constructed many miles of low-cost bituminous surfaces. These surfaces, although pleasantly free from sun glare and reflection during bright days, are usually for the same reason deficient in visibility at night. The absorption of light by the dark roadway surface at night makes the marking of curves or of any direction deflections desirable for fast driving.

The Oklahoma, Kansas, Missouri and Iowa State highway departments for some time have specified a standard guard fence carried on round southern yellow pine posts which have been pressure treated by a standard empty-cell process, according to the *Wood Preserving News.* This guard fence is built by the contractor at the time of construction of each project. The posts are usually painted with aluminum after six months' exposure. Flat curves or those on low embankments are often not considered sufficiently dangerous to traffic to require guard fence protection.

The maintenance department of the State of Kansas is now marking all deflections on oil surfaced roads that have not already been equipped with guard fence. This is purely a matter of guiding traffic at night at these points. Painted posts are placed 50 ft. apart on the outside of all curves having radii of less than 500 ft. and 100 ft. apart on all curves of radii greater than 500 ft. It is required that the top 24 in. of all creosoted posts be painted with aluminum. No fence or cable is used.

Many of these pressure creosoted posts now being used for this purpose were originally placed in guard fences in other locations as early as 1919. Because of changing highway conditions, many of these creosoted posts are now probably serving in their third or fourth installation.

The Batching Plant in Concrete Paving Work

(Continued from page 18)

Effect of yard layout and management on magnitude of time constant

GOOD YARD LAYOUT AND ABLE MANAGEMENT

Number of studies averaged	3	3	3	3
Size of trucks	1-batch.	2-batch.	3-batch.	4-batch.
Load aggregate ..... seconds	10	38	70	98
Load cement bags .....do .	12	29	54	84
Drive and maneuver .....do .	48	65	87	62
Total net yard constant....do .	70	132	211	244

AVERAGE YARD LAYOUT AND MANAGEMENT*

Size of trucks	1-batch.	2-batch.	3-batch.	4-batch.
Load aggregate .....seconds	15	59	114	190
Load cement bags .....do..	28	80	106	110
Drive and maneuver .....do..	81	99	102	100
Total net yard constant ....do..	124	238	322	400

POOR YARD LAYOUT AND SLACK MANAGEMENT

Number of studies averaged	3	3	3	3
Size of trucks	1-batch.	2-batch.	3-batch.	4-batch.
Load aggregate .....seconds .	33	91	163	196
Load cement bags .....do .	51	89	118	148
Drive and maneuver .....do .	210	218	193	132
Total net yard constant....do .	294	398	474	476

*Average values for more than 100 jobs.

It will be noted that the time differential in favor of the good as against the poor layout averages about 4 minutes, while the good layouts also show a differ-

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912. OF PUBLIC WORKS, published monthly at New York, N. Y., for Oct. 1, 1932.

State of New York } ss.
County of New York }

Before me, a notary public in and for the State and county aforesaid, personally appeared J. T. Morris, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Public Works Journal Corp., 310 E. 45th St., New York, N. Y.; Editor, A. Prescott Folwell, 310 E. 45th St., New York, N. Y. Managing Editor, none; Business Manager, J. T. Morris, 310 E. 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Public Works Journal Corp., J. T. Morris, W. A. Hardenbergh, A. Prescott Folwell, S. N. Hume, Croxton Morris, S. W. Hume, all of 310 E. 45th St., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) Swetland Publishing Co., 239 W. 39th St., New York, N. Y. (Stockholders unknown.)

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

J. T. MORRIS.
(Business manager.)

Sworn to and subscribed before me this 28th day of Sept., 1932.
(Seal.) R. CROXTON MORRIS.

NOTARY PUBLIC, WESTCHESTER COUNTY, N. Y. Cert. filed in N. Y. Co. No. 317, Reg. No. 3M225. Commission expires March 30th, 1933.

ential of from about 1 to nearly 3 minutes below that of the average yard constant for all jobs. These are items too large to be ignored, as they may readily mean an unnecessary but permanent addition to the hauling equipment of at least the equivalent of one 3-batch truck.

The standing time for a truck in taking on one batch of sand and coarse aggregate may be 10 to 20 seconds, but 20 to 40 may be necessary for weighing the second and third batches, because the first batch can be weighed into the hopper while the truck is coming in. If there are separate bins for sand and for coarse aggregate, the time is increased 40 to 50 seconds for 1-batch trucks, 75 to 90 seconds for 2-batch trucks and 100 to 125 for 3-batch, extra time being necessary for backing under the successive bins. If the drive is straight through, these figures can generally be reduced by from 20 to 40 seconds.

Yards vary greatly in length of yard circuit and in roadway conditions, the driving time in the yard thus varying from 35 seconds to 5 minutes; 50 to 100 seconds represents good layout and management.

In highway construction especially, the question often arises as to whether to build entirely from one plant set-up, or to move to another when the work has reached a considerable distance from the plant. Short hauls require less vehicles and the routine work is usually easier to organize and maintain. But moving the plant involves additional cost and interruption of the work for one or more days; and the railroad facilities may be much better at one site than at the other.

The following formula is given for estimating the probable cost of hauling batches from a given site.

$$K=\frac{C}{60N}\left(T+\frac{60}{S}(L_1+L_2)\right)W.....$$

Where K=the cost of the hauling for section (L_1—L_2).

C=the hourly cost or rental value for the size and type of truck to be used.

N=the number of batches carried per load; or if tons per load, W is also given in tons.

T=the total truck constant or average time the truck spends each trip at the mixer and in the yard, including all necessary and regular delays, in minutes.

S=the average actual round-trip speed in miles per hour while the truck is on the road.

L_1=the dead-haul or hauling distance in miles from batcher plant to beginning of concrete slab being laid.

L_2=the total length of haul in miles from batcher plant to end of the section under consideration.

W=the total number of batches (or tons if N is given in tons per load) to be hauled for the section under consideration. If the cross section is not uniform a separate computation should be made for each distance involving a changed section length.

In determining whether or not the hauling should be done from two or more yards instead of from one, the following points should be given careful consideration in addition to the solution of the cost of the haul itself:

1. The cost of moving and setting up on the new location.
2. The cost of materials laid down at the new yard.
3. Track and switching facilities at the new yard.
4. Adaptability of the available space for a yard layout.
5. Hauling and traffic conditions from the proposed location.
6. Probable time constant for new yard and yard operation cost.

Every case must be carefully investigated. Such items as freight rates, land rentals, switching and track facilities, as well as reliability of delivery of materials are seldom the same for any two possible locations and may be sufficient to overbalance any possible saving from the shorter haul.

An item which must not be overlooked in selecting the site for a yard is that of traffic conditions in connection with the yard. Congested highway traffic limits speed and tends toward irregularity. Railroad grade crossings over main lines carrying heavy traffic are always dangerous, while those over freight-passing sidings are apt to occasion frequent and sometimes long delays. Conditions have been found where as many as two extra 3-batch trucks and a crossing watchman were required to prevent serious delays to the mixer; equivalent to a tax of 12 to 15 cents on every batch handled when production is high, and correspondingly more when production is low.

The above is condensed from an article by Andrew P. Anderson, highway engineer, Division of Management, U. S. Bureau of Public Roads, in *Public Roads*, the official publication of that bureau.

Labor Benefits by Bituminous Surface Treatment Works

(Continued from page 10)

although the chief aim was to give the men employment.

The photographs show clearly the operations on this work. No. 1 shows two gangs of men sweeping a road by hand. No. 2 shows a gang of men salvaging the bladed-off aggregate by screening. No. 3 shows the county's new distributor in operation on an Auglaize county highway. No. 4 shows several men placing the salvaged aggregate as covering material. It will be noted in this picture that the center portion of the road is not covered. This portion was covered by additional aggregate purchased, hauled and spread by truck. No. 5 shows an Adams multiple drag, drawn by an International tractor and used for mixing and leveling.

The following treatments have been given to 25 miles of highways in Auglaize county, using the above method, at an average cost of approximately $800 per mile: A prime penetration coat of one-quarter gallon of C. T. was applied and allowed to stand 24 hours, after which a second coat of .4 gallon per sq. yd. of M. T. No. 1 or A. E. No. 3 was applied and covered with the salvaged aggregate, plus the additional amount of new material required, which aggregate was mixed by dragging and was rolled with a 7-ton roller the following day.

Auglaize county never had any tar surface roads until the present surveyor took office three years ago last January. At the writing of this article we have completed on our county system 85 miles of bituminous surface treated roads, 60 miles having been completed the past three years by contract method. They have been giving excellent service and have rquired only reasonable maintenance. No assessments were made against any abutting land-owners in this county for this work, but the entire improvements were paid for from the gasoline tax funds. Auglaize county receives no money from tax levies or other sources into their highway and bridge fund other than the gas tax and tag tax money.

Efficient Equipment for Keeping Roads Open in Winter

CONSIDERABLE differences of opinion exist in regard to the type of equipment most efficient for snow removal purposes. Many of these differences are based on local conditions. It is but natural that equipment suitable for the heaviest type of removal work, such as is encountered in the Rocky Mountains, might be inefficient when employed in southern New York or New Jersey. With a view of presenting the practice in a number of sections of the country, experiences from several states have been obtained.

New England

Blade plows attached to trucks have been found to be most efficient for ordinary plowing in Massachusetts, while for widening work "V" plows and trucks are used. For extreme cases, this state employs tractors with "V" plows and has one truck equipped with a rotary plow. The winters of the past two or three years in Rhode Island have brought comparatively light snowfall, and roads have been kept open without difficulty by the use of trucks with straight blade plows, though tractors and rotary plows are available and used for severe storms. Vermont has found that fast trucks are the most suitable for clearing the main roads, but its snow removal equipment includes four large fast trucks, four-wheel driven, several tractors, and a quantity of snow plows for which private trucks are hired. Snow equipment is also hired from the towns where it is available.

New Hampshire states that it has found best results to be obtained by the use of trucks with blade plows where the plowing can be done in advance of drifting, since if the work can be started during the early stages of the storm, no difficulty will be encountered. Each piece of equipment is given a mileage of 10 to 25 miles. The state also has some heavier equipment, such as rotary plows, for use on the mountain roads in order to widen out after the blade plows have gone through. These are usually teamed up with tractors.

The East and Midwest

Pennsylvania finds that mobility is desirable in snow removal equipment, and states that it is generally recognized that light equipment is most efficient for light work, but that heavy drifts call for high power; and if slow and costly hand shoveling is to be avoided, rotary plows should be available for sections of the road where there is continuous or, within a storm period, recurrent drifting.

For removing heavy drifts, the Illinois Division of Highways is equipped with large trucks having 100-horsepower motors, and with "V" type snow plows built according to its own design. The regular patrol trucks are 1½-ton capacity and are equipped with straight-blade snow plows. These are capable of moving loose snow which does not exceed a foot in depth. Highways are divided into sections from 20 to 40 miles in length.

The backbone of the Iowa snow removal organization is a fleet of high-speed truck plows. The trucks are 100 to 125 horsepower, and the plows are of the "V" type. In addition to these high-speed trucks, the state has a number of rotary plows and also a number of the slower moving tractor plows. For light snows, maintainers and light truck plows are very effective.

In the southern half of Michigan, the great majority of snow storms are handled with one-way blade plows, 10 feet wide and 3 feet high, which are mounted on motor trucks. This type of plow is also used in the northern section to supplement the work of the "V" plows. Another useful plow has a flaring moldboard; this is intermediate between the blade and the "V" plows. The latter are used for a great deal of the work in the northern part of the state and for the heavier snows in the southern part. Truck-driven rotary plows are used effectively for widening, and, by throwing the snow back, avoid the formation of high banks. In selecting equipment for snow removal, consideration is and should be given to the suitability of the motorized units for use on other maintenance and construction work during the remainder of the year.

Farther West

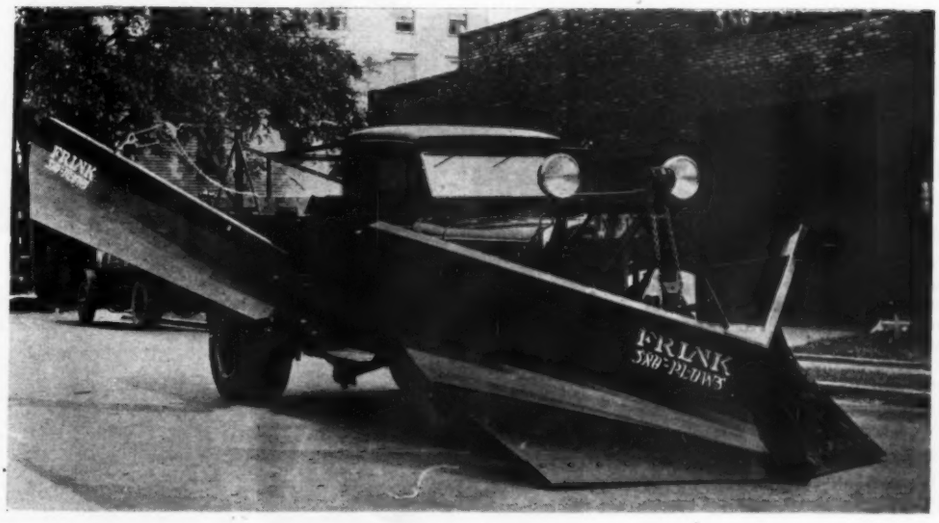
Snow removal practice in South Dakota was described in an article in the September issue of PUBLIC WORKS. In North Dakota it has been found that "V" type displacement plows, mounted on three to seven-ton four-wheel-drive trucks, followed by rotary plows, has been the most successful equipment. Experience has pointed out the wisdom of avoiding the piling of snow along the roadside; instead, the road is opened with a displacement speed plow, which is followed by a rotary plow to clean up and remove banks. Conditions in this state are considered very difficult, and it is stated that equipment found successful in a great many other localities will not combat the severe conditions in North Dakota.

In the lower altitudes, in Idaho, where the snowfall is light and very little drifting occurs, light trucks with reversible blades in front quickly remove the snow. Where the snowfall is heavy, or where drifting prevails, heavy trucks with "V" plows and interchangeable rotaries are used, and there are some tractor-equipped rotaries for use on short stretches where severe drifting occurs.

The equipment found most suitable in Nevada consists of push plows on four-wheel-driven trucks. The "V" type are used when the snow is two feet or more deep. These are equipped with a rotary attachment, such as the Snow King or the Rightway.

California has found a one-way plow, mounted on a four-wheel-driven truck, very efficient on depths of snow not greater than two feet. When the depths range from two to five feet, the lighter truck-driven type of rotary is used. When the depths are greater than this, the work is handled by one-way speed plows, supplemented by truck-driven rotaries of either the augerblower or shovel types. Altogether, the state uses 30 trucks and 17 tractors. There are about 600 miles of heavy snowfall area and about 1,400 miles additional where severe storms may require snow removal work.

FRINK SNO-PLOWS



Model 48S Sno-Plow and Model 10R Leveling Wing attached to a 3-Ton Motor Truck

THE answer to the snow removal problem simmers down to well defined facts which are governed by the answers to the following questions: 1. What type of motive power is available for snow removal work? 2. From what type of roads is snow to be removed? 3. What are the average and maximum depths of snow which will have to be removed? 4. What is the mileage of roads from which snow will be removed? ¶ FRINK Sno-Plows are adaptable to a greater variety of the above conditions than any other snow plow because there is a greater variety of sizes from which to select and because they are designed by one of the pioneers in the manufacture of snow removal equipment, after years of experience and intensive study of all kinds of snow conditions from the Arctic regions of northern Canada to the southern limits of the snow belt in the United States.

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* *Names on request*

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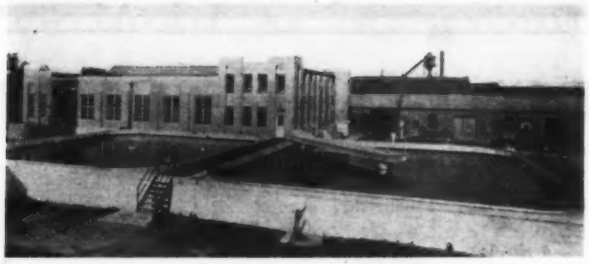
Cast iron mains are the most economical because they last longest. Their useful life is more than a century. For further information, write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 122 South Michigan Avenue, Chicago, Ill.

Sanitary Engineering

Water Supply — Sewerage — Refuse Collection and Disposal — Sanitation



Rear of filtration plant of Peru, Ind., showing settling basins with traction clarifier. *(See page 14)*

Drawing Cool Water From a Steel Reservoir

McCloud, Calif., with about 3,000 population, obtains its public water supply of 2.5 to 3 million gallons a day from two springs, the flow from which is discharged into a steel above-ground reservoir 104 ft. diameter and 20 ft. high, located 190 ft. above the town.

In order that the spring water may, so far as possible, reach the consumers without being warmed by exposure to the sun, a 6-ft. diameter tank was built inside the large tank and about 18 in. from its shell, rising a few inches above its top and extending through its bottom. An opening in the wall of the smaller tank, near the bottom of the larger, provided with a 30" "Calco" sluice gate and a double screen, gives communication between the two tanks. The gates are not generally closed except to provide for cleaning the large tank. The 16-in. outlet is connected to this smaller tank.

The spring water enters over the top into the smaller tank, which it leaves through the outlet without passing into the big tank, thus entering the underground pipe about two minutes after it enters the tank. When the spring flow exceeds the consumption, the surplus fills the reserve in the big tank until this reaches the level of the overflow; when consumption exceeds spring flow, which is about 20 per cent of the time during the day, the necessary amount enters from the bottom of the larger tank, where the water is cooler than at the top. There is generally a difference of 15° between the temperature of the water in the small tank and that in the larger tank.

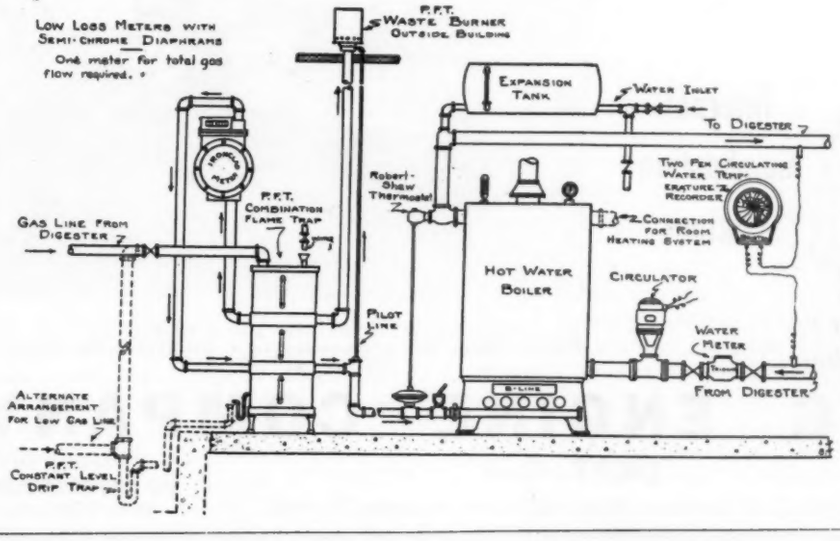
Emergency Treatment for Tastes and Odors

On Tuesday, August 23d, a very objectionable taste and odor was noted in the Valparaiso (Indiana) city water supply by representatives of the Engineering Department (of the State Board of Health) who were passing through the city. The source of this condition was traced to an increased algae growth in the raw water supply and arrangements were made by this Department with the Valparaiso City Water Department on that date to secure a supply of powdered activated carbon as quickly as possible. A shipment of carbon from Chicago was on hand the following day. Experiments were begun immediately to determine the proper dosage and the most effective point of application.

Due to the necessity for immediate action, it was decided to apply the activated carbon through the dry chemical feed machine to the raw water by mixing it with the alum. A dose of thirty-five pounds per million gallons was found necessary in the laboratory for complete taste removal, and later in the afternoon on August 24th the treatment on this basis was started.

On the afternoon of the twenty-fifth a final visit was made and it was learned that the objectionable taste and odor was by that time completely eliminated at the plant and from the distribution system with the exception of a few outlying districts where "dead-ends" exist.

Treatment with activated carbon will be continued until the source of the taste and odor has disappeared from the raw water supply. *From the Monthly Bulletin, Indiana State Board of Health.*



Diagrammatic Arrangement of Equipment for Heating Water by Sewer Gas, suggested by the Pacific Flush Tank Co. *(See article "Mechanical Equipment in Sewage Treatment Works" on page 21 of this issue.)* *The P. F. T. combination flame trap combines the functions of the condensate, relief and flame traps ordinarily used. If the gas line from the digester is brought in below the level of this combination trap, as shown by the dotted lines, a drip trap should be used.*

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 61

Ammonia-Chlorine Treatment at St. Cloud Gives Improved Results at Less Cost

ST. CLOUD, Minn., takes its water supply from the Mississippi river, and finds it necessary to treat it for color, which varies commonly from 20 to 100 p.p.m., for turbidity ranging from 5 to 15, and for bacteria ranging from 250 to 1,500 at 37.5° C., with no color-free samples.

The water first is aerated by trickling, through small holes in a tank, into a collecting basin beneath. Thence it flows through two pipes to two mixing chambers, from these to covered settling basins with a normal retention period of about 5 hours, and then to four filters, each with a rated capacity of 900,000 g.p.d. The filter effluent is collected in a 240,000-gallon clear well, from which it is pumped into the distribution system. Alum is fed ahead of the mixing chambers.

Chlorine was used as a disinfectant, and was applied to the filter effluent only prior to August, 1930; but as the river water at times had a B. coli index of 10,000 per 100 c. c., which placed too great a burden on the filters, prechlorination was tried, 2 p.p.m. of chlorine being applied in the collecting tank. This reduced the bacteria in the settled water to about 40% of the raw water count, the residual chlorine at this point being 0.5 p.p.m. The filters reduced the count about 40% but only a few of the samples were color-free, and a second chlorine dose of about 0.5 p.p.m. was added, giving 100% color-free samples, an average bacterial count of 3, and a chlorine residual of about 0.08.

The use of 2.5 p.p.m. of chlorine involved considerable expense; also chlorine tastes were occasionally noticed in the water (not chloro-phenol, as there seem to be no phenol substances in the river water), and it was decided to try whether the use of ammonia would not remedy both of these. An ammoniator was obtained and anhydrous ammonia fed into the aerator tank at the rate of 0.36 p.p.m., and 0.5 to 0.6 of chlorine was introduced between this tank and the mixing chamber, and a final dose of 0.25 to 0.30 p.p.m. to the filter effluent; 0.75 to 0.90 p.p.m. as compared to 2.5 previously.

During this treatment the bacteria counts averaged 440 per c.c. in the raw water and 14 in the settled water; while the colon-free samples showed two weeks 75% free, two weeks 99% and eleven weeks 100%. The chlorine residual in the settled water averaged 0.3 to 0.35. Meantime the water leaving the filter showed a higher bacterial count than that entering it during the first six weeks, although the first three weeks the effluent samples were 99% colon-free, and the last twelve weeks 100%. At no time during the first four or five months did any residual chlorine pass the filter; but due to the chlorine application to the effluent, more or less residual was found in all parts of the distribution system. Following this period the filter effluent began to show residuals, which increased until, in February 1932, the filter effluent contained 0.24 to 0.30 residual and post-chlorination was found to be unnecessary.

When the use of ammonia began, the proportion of chlorine to ammonia of 2 to 1 was tried, as being common practice; but experiments made with this water indicated a 7 to 1 ratio gave better results. In winter, when the raw water underwent little if any change, the amount of ammonia was lowered little by little and, by noting the amount of residual, the correct proportion was determined; the residual dropping immediately when the ammonia was reduced below the 7-1 ratio. Checking during the warmer months gave the same result.

In the spring of 1931 an excess of cyclotella in the water caused distinctly fishy taste which the ammonia-chlorine did not prevent. Activated carbon was tried with success in eliminating this taste, but complicated the other treatment as it acts as a dechlorinator, the dechlorination taking place while the water was passing through the filters. Therefore, when carbon is being used heavily, about 0.1 p.p.m. of chlorine is added to the effluent, bringing the final residual to 0.15 or 0.20.

At first a mixture of carbon and water was applied directly to the filter at intervals of 8 hours, then of 4 hours, 2, and finally continuous feeding was decided upon and a type "O" W & T continuous feed machine was obtained. This feeds a mixture of carbon and water into a galvanized iron tank in which the water level is maintained constant. A small centrifugal pump discharges the mixture from this tank to wherever desired. When applied directly to the filters, they matted rapidly, requiring back washing. Applying it at the outlet of the settling basins only partly remedied this, and the practice finally decided on was to apply it about 75 feet ahead of the filters, allowing most of the carbon to settle in the settling basins.

St. Cloud has found the ammonia-chlorine process effective in preventing aftergrowths in the mains, and algae in the raw water are reduced 95% or more before it reaches the filters. The sediment on the bottoms of the settling basins is inert and inoffensive where formerly it was gaseous and obnoxious.

In dealing with algae, St. Cloud water officials developed an apparently new benefit and procedure of chloramine treatment. Since destruction of algae depends upon oxidation and the addition of ammonia to chlorine destroyed its oxidizing powers, by raising the chlorine-ammonia ratio from 7:1 to 10 or 12 to 1 in algae season the excess chlorine was free to oxidize the algae; which it apparently did, since the chlorine residual did not increase. Moreover, the excess chlorine helped to destroy the color, and less alum was necessary. (Alum dosage is regulated by color rather than by turbidity at St. Cloud). This practice would probably result in chloro-phenol tastes, however, where the raw water carried phenols.

As a further check on the oxidizing effect of chlorine, the chlorine dose was left constant and the ammonia increased to give a 7-1 ratio, when the bacterial count and the color increased and the tap water gave off a musty odor; which conditions disappeared when the ratio was returned to 11-1.

The bacterial reduction in the settling basins is now so great that the filters have little bacterial removal to do. Consequently less wash water is required. Also the 30-inch thickness of sand, designed

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for a heavy bacterial load, is now unnecessary, and 18 inches is found to give an equally good effluent while passing 50% to 100% more water. C. L. Ehrhart, superintendent of the water works, says: "It has never been necessary in this plant to filter above the rated capacity. We feel, though, that when it does become necessary we can obtain much greater flow than the rated capacity. This will prevent the necessity of spending additional funds for increased filter capacity. We believe that other water plants could obtain equally good results by the use of this method, and if such a practice were carried out in general it would make a great saving throughout the country by lowering the cost of new filter units and delaying, in many cases, the necessity of additional units."

The above is an abstract of a paper read by Mr. Ehrhart before the Minnesota Section of the American Water Works Association.

Travel of Underground Pollution

Recent studies made by the New York State Department of Health relative to the travel of underground pollution at Rockville Center, Nassau county, were undertaken as a result of charges brought against the village that seepage from the percolation beds of the local sewage treatment plant was seriously polluting a small watercourse, the headwaters of which are located about 1,500 feet below the plant. The community is served by an activated sludge sewage treatment works, the final effluent being discharged onto natural sand beds, thence seeping into the natural ground waters of the region.

Numerous bore-holes to the ground water were installed between the plant and creek. Samples collected from these holes were tested for chlorides and the underground path of the effluent accurately determined. Wells were then driven along the line of seepage and samples taken for chemical and bacteriological examination.

The studies proved that bacterial pollution was effectively removed from the effluent after passage through less than 400 feet of soil (principally fine sand). The bacterial analyses upon samples from the various driven wells penetrating the path of seepage were all negative for *B. coli*.

Chemical pollution as represented by free ammonia, however, was demonstrated to have been carried underground more than 1,500 feet in the travel of the seepage from the percolation beds to the creek. Although the presence of such pollution in the percolation bed seepage is regarded as having no public health significance, it may be a factor in the encouragement of algae growths in the surface stream.

Another interesting phenomenon observed was that the path of seepage narrowed rapidly from a width of about 800 feet at the plant site to a width of less than 100 feet at a point about midway between the plant and creek.

A Double Cylindrical Concrete Reservoir

An unusual reservoir was put into service last August at Derbyshire, England. It is really two cylindrical reservoirs one inside of and concentric with the other, the outer being 101 ft. 6 in. internal diameter and holding 26 ft. 6 in. depth of water; the inner having about half this diameter. The inner tank is provided to hold a reserve supply, which will maintain its full head no matter how low the water may fall in the outer annular space. The interior

cylinder also serves to support the roof, which covers both reservoirs.

The wall of the outer reservoir is 6 in. thick at the top and 25 in. at the base, and that of the inner reservoir is 5 in. at the top and 14 in. at the base. Increases in thickness are made by offsets both inside and out, and horizontal construction joints were made to coincide with these offsets; while nine vertical expansion joints were constructed at uniform intervals around the circumference. Each horizontal and vertical joint was made watertight by inserting a lead plate across the joint, while the inside of the joint was pointed with elastic material. The roof is completely separated from the walls by sliding joints so as to avoid transmission from one to the other of stresses due to expansion and contraction.

The floor of the reservoir, although resting on the ground, is supported by a system of 130 concrete pillars which extend to solid foundation 26 feet below the floor level. It is therefore essentially a concrete water tower with the legs and part of the tank buried in the ground.

Sewer Rental in Ohio

A pamphlet with this title has recently been published by the Ohio Department of Health which tells the history of this practice in that state and the conclusions therefrom.

The state law providing for sewer rentals became effective in July, 1923, since which time 21 municipalities have adopted the practice. (Two—Lima and Delphos—were not added to the list until this year and are not included in the total of the Am. Soc. of Municipal Engineers report.) Of these 21, "10 employ a schedule of charges based upon water consumption as revealed by the meter records of the water department." This is "more applicable to municipalities where the water works are municipally owned and where the water services are very largely metered. . . . Where water meter consumption data are not available, average fixed charges may be applied with fairness. For certain sewer connections it may be necessary to approximate the flowage in volume by measurements repeated from time to time, such as for industrial establishments, hotels or other public buildings having individual water supply other than from the city, or where deductions of volumes must be made to account for cooling or condensing water entering the storm sewers not connected to the disposal plant."

Eleven of the cities use the flat rate basis in one of three ways: 1—A uniform charge per connection regardless of type of premises. 2—A charge per connection varying according to the number and type of fixtures in the building. 3—A charge varying according to the type of premises served. Four municipalities use the first, 2 use the second and 5 the third.

The flat rate basis is not so scientific or fair as the water consumption but is "probably unavoidable for municipalities where the water works are privately owned and operated, since in such cases meter records are not conveniently available to the city officials," or "where the water services are not upon a metered basis."

"Based upon the experiences of Ohio municipalities the financing of costs of maintenance and operation of sewerage and sewage treatment and disposal works may best be provided for by means of the sewer rental plan. It would appear that a definite enabling act permitting such a plan is a wise provision. The idea of financing under the sewer rental plan appears eco-

nomically sound. The charges necessary to accumulate the revenues for maintenance and operation purposes are small, are entirely reasonable, and do not offer a financial burden to the user of the sewer connection. The sewer rental plan is a fair and equitable basis for placing the charges for maintenance and operation costs where they belong—upon the user of the system.

"While it is possible under such a plan to include in the charges an amount to enable the retirement of sinking fund charges on bonded indebtedness for the construction of main sewerage and sewage disposal works, it seems best that the financing be limited to the maintenance and operation costs only. This is particularly true of small municipalities if the rentals are to be kept at a reasonably low figure. This conclusion is also reached when account is taken of the benefits; that is, installation of sewerage and sewage disposal benefits even vacant property by enhancement of potential value. Therefore, all property of the community should be taxed to pay for such an improvement. Operating costs are more equitably chargeable to the users of the system.

"Collection of the sewer rental charges appears to offer no particular difficulty and little or no extra effort is required over that now being used for collection of water charges. It is probably true that a provision should be made for collection of delinquent accounts if and when found to be necessary.

"It is the poorest economy to construct sewerage and sewage works costing thousands of dollars without accompanying the engineering and construction plan by a previously determined financial plan for meeting the maintenance and operation costs of the investment."

Sewer Rentals on a Flat Rate Basis

Where sewerage is paid for not from the general taxes or by assessment, but by means of rentals—charges for the use of the system, a common method of fixing the charge is to make it a given percentage of the water meter bill, where metering is practically 100%. But where metering is not general, a flat rate may logically be used, based upon the relative amounts of water used in the various plumbing fixtures. Annual charges calculated on this basis for Lower Merion Township, Pa., are as follows:

Sinks—$3.50 for first; $1.50 for each additional.
Water closets—$2.50 for each.
Basins—$1.00 each.
Stall showers—$1.00 each.
Bathtubs—$1.50 each.
Laundry tubs—$1.00 each part.

The minimum rental for dwellings is $4.00 per year; other buildings—$5.00 per year. Factories, hospitals and colleges are given special rates at the judgment of the committee appointed to have charge of the sewers. In some cases the rate for this type has been placed at a flat rate of $1.00 per person per year for the number of persons using the building.

The Water Wheel

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17. s. Paratyphoid Pollution in London's Water Supply, p. 434.

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18. t. Beach Drainage Safeguards Alexander (Hydraulic-fill) Dam. Joel B. Cox, pp. 466-469.

Journal, American Water Works Association, October.

19. History and Development of Turbine Well Pumps. David J. Conant, pp. 1499-1511.
20. Construction and Maintenance of Deep Wells in Sand Strata. W. G. Lanham and Thomas H. Allen, pp. 1512-1522. William F. Laase, pp. 1523-1533.

21. Loss of Wells in Construction and Operation. D. A. Lane, pp. 1534-1538.
22. The Memphis Water Supply. F. G. Cunningham and Wellington Donaldson, pp. 1539-1550.
23. Developments in Metering and Controlling Equipment. Charles G. Richardson, pp. 1551-1557.
24. Changes in Cost of Water Works Labor and Materials. William W. Brush, pp. 1558-1568.
25. Influence of Water Works on Fire Protection Classification. George W. Booth, pp. 1569-1581.
26. Linings for Cast Iron Pipe. D. B. Stokes and H. G. Reddick, pp. 1582-1589.
27. Friction Coefficient Tests on Cast Iron Distribution Mains with Centrifugally Applied Bitumastic Enamel Lining. Elson T. Killam, pp. 1590-1608.

Proceedings, Am. Soc. of Civil Engineers, October.

28. *t.* Tests for Hydraulic-Fill Dams. Harry H. Hatch, pp. 1301-1342.
29. *t.* Determination of Principal Stresses in Buttresses and Gravity Dams. Discussion of Paper by W. H. Holmes, pp. 1393-1400.
30. *t.* Stresses in Inclined Arches of Multiple-Arch Dams. Discussion of Paper by Goodall and Nelidov, pp. 1401-1416.
31. *t.* The Compensated Arch Dam. Discussion of Paper by A. V. Karpov, pp. 1417-1424.

Surveyor and Municipal and County Engineer, September 23.

32. Milford Haven New Waterworks, p. 255.
33. Water Supply in An Urban District (Ilkley, England). A. Skinner, pp. 263-264.

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34. Kingsbridge and Salcombe Water Board's Works. J. M. Linton Bogle, pp. 305-306.

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35. Purification of Public Water Supplies in the Orient. Jal D. Edal Behram, pp. 333-337.
36. Specifications for Powdered Activated Carbons. John R. Baylis, pp. 341-344.
37. Convention of New England Water Works Ass'n, pp. 345-350.
38. Operation and Control of An Industrial Water Supply Reservoir. P. W. Frisk, pp. 355-356.
39. Where Dry Hypochlorites Pay in Water Works Practice. J. A. Kienle, pp. 359-361.
40. Pumping Plant Economies. L. A. Jackson, pp. 362-364.

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41. Gearing for Pump Drives. Maj. F. Johnstone Taylor, pp. 1208-1209.
42. West Filtration Plant, Erie Auxiliary Water System. John T. Campbell, pp. 1210-1214.
43. Legal Distinction Between Municipal and Governmental Duties of the City. Leo T. Parker, pp. 1213-1215.
44. Water Purification Processes Featured at N. E. W. W. A. Convention, pp. 1216-1221.
45. Experiences with Chloramine Treatment. Symposium, pp. 1222-1224.

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46. Water Department Builds Good Will by Educating the Consumer. Chas. S. Denman, pp. 1258-1261.
47. New England Water Works Convention at Springfield (Conclusion), pp. 1262-1267.
48. Loans Granted by R. F. C. Now Exceed $43,484,000 for Water Works Construction, pp. 1268-1269.
49. How Meter Deposits Are Handled. Symposium, pp. 1274-1277.

Journal, Pennsylvania Water Works Operators' Association, 1932 Meeting.

50. Chlorinating a Gravity Water Supply at Scottdale. F. W. Buck, pp. 10-12.
51. Experience with Chlorine-Ammonia Treatment. J. C. Degroot, pp. 16-18. J. G. Dell, pp. 18-19. R. W. Woodring, pp. 28-29.
52. Clarification by Coagulation Without Filtration. C. E. Burlingame, pp. 12-16.
53. Coagulation Troubles. Thomas Jones, pp. 21-22.
54. Experience with Continuous Use of Activated Carbon in Taste Prevention. Emerson Foster, pp. 20-21.
55. Taste and Odor Control with Activated Carbon. B. F. Johnson, pp. 43-52.
56. Correction of Acidity. E. O. Horner, pp. 23-24.
57. Cause and Cure of Red Water at Eagles Mere. R. D. Kehrer, pp. 24-26.
58. Copper Sulphate and Fish. Walter Stockbine, pp. 26-27.
59. Elements of Water Bacteriology and the Reasons for Their Application. John J. Shank, pp. 32-42.
60. Use of Bleaching Clay in Water Purification. Edward M. Slocum, pp. 53-64.
61. Use of Absorbing Clay for Removing Taste and Odor Producing Substances from Water. Rennie I. Dodd, pp. 65-67.
62. Filter Sand and Gravel. R. F. Abel, pp. 68-73.
63. Cause, Prevention and Elimination of Mud Ball Formation in Rapid Sand Filters. Edward S. Hopkins, pp. 74-82.
64. Sterilizing Effect of Acid Waters. Lewis V. Carpenter and Edmond T. Roetman, pp. 83-90.
65. Leakage Survey at Reading, Pa. A. R. O'Reilly, pp. 91-97.
66. Water Bearing Strata. Geo. H. Ashley, pp. 98-101.
67. Water for Industrial Purposes. A. S. Behrman, pp. 102-109.

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68. *n.* Prize Design Tank Completed at Towson, Md., p. 3.
69. Novel Arrangement in McCloud Steel Reservoir to Keep Water Supply Cool, p. 4.
70. *n.* Water Pressure Uniform at Litchfield, Ill., p. 6.
71. Demopolis, Ala., Builds Up Water Works System, p. 8.

Miscellaneous Reports.

72. Solution of Special Problems in Pipe Flow by Graphical Analysis. Grant K. Palsgrove. R. P. I. Bulletin No. 37.

Developments in Water and Sewerage Equipment

The Chronoflo Meter

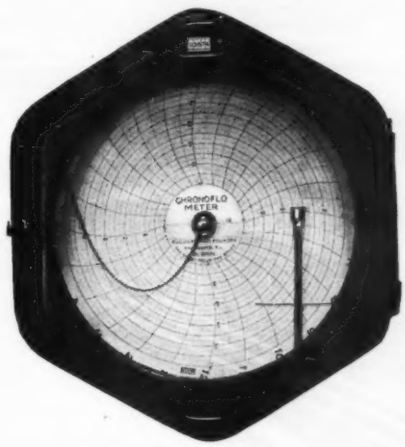
Wide measuring range, accuracy, and abundance of power are features of the new Chronoflo Meter which Builders Iron Foundry, Providence, R. I., have announced. A 12-page illustrated Bulletin, No. 261, describes the operation and construction of this unique electrically operated meter. Specifically, a chart record reliable to 1/12th the maximum rate and a total flow register accurate to 1/20th of the maximum flow is promised. This will appeal to all who use flow meters on steam, air, gas, and liquid lines where there are wide seasonal, day and night, or hourly variations in the rate of flow.

The Chronoflo Instrument, which may be used with either a Venturi Tube or an Orifice plate, utilizes four products of modern electric research—the Telechron Motor, Mercury Switch, Power Relay, and Electro-magnetic clutch—as the foundation for its operation.

Economy in Cleaning Filter Sands Annually

Filter sand can be reclaimed by cleaning, and it is economical in many filter plants to wash or clean the sand every year. A sand cleaner recently developed will remove more than 95% of the encrustance on the sand particles with a loss of less than 1% of sand. This cleaner, which consists of two units, may be located outside or inside, below or above the filter beds. The sand is handled manually only once, but upon completion of the washing operation, it is automatically returned to its original bed or to another bed.

This cleaner is particularly effective where mud balls are present and where the sand has been encrusted by ordinary impurities or by the presence of sulphite or other trade wastes. It is made in three sizes for large or small plants. Cost of operation is reported as but a fraction of the cost of sand replacement. The Robertson cleaner, described above, is made by the Simplex Valve and Meter Co., Philadelphia, Pa.



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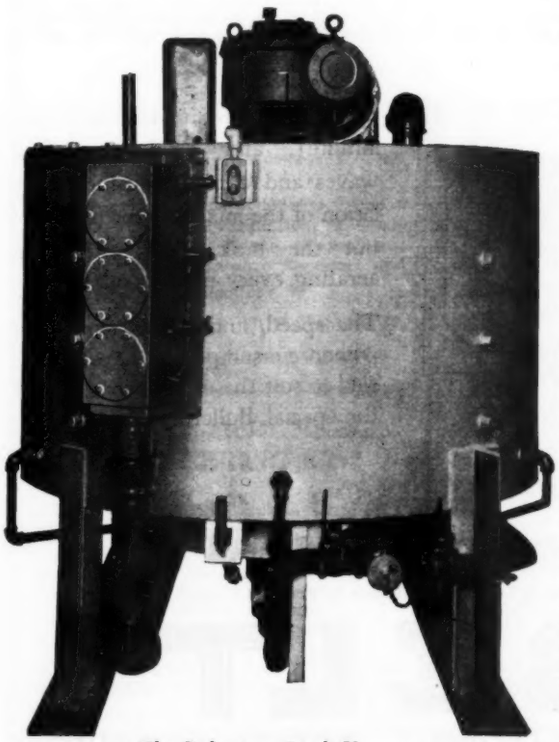
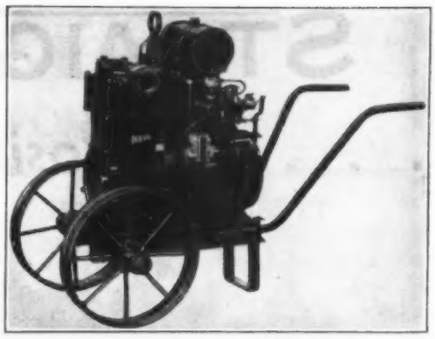


The Robertson Sand Cleaner

For Ammoniating Small Water Systems

Hoke, Inc., 22 Albany Street, N. Y., has developed ammonia control apparatus for experimental work and for small water systems. The model LN is the most popular control for nitriding and similar small jobs where the flow should be indicated. The left gauge shows the pressure in the cylinder, and the right gauge indicates the flow in cubic feet per hour. The needle valve gives easy adjustment.

The model shown at the right is the LN. The scale shows the relative size of the equipment which is suitable for small jobs.



The New Novo Pump.

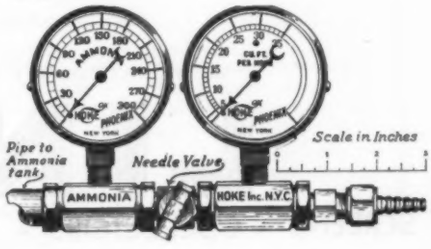
A Self-Priming Centrifugal Pump

A self-priming 2-inch centrifugal pump with a capacity of 7,500 gallons per hour at 15-foot lift, and a total lift available of 55 feet, has been brought out by Novo Engine Co., Lansing, Mich. It is completely equipped with anti-friction bearings, and is mounted on a 2-wheel truck, but can be furnished on skids or on a trailer. The engine may be replaced with an electric motor.

New Standardized Line of Diesels

Covering power requirements from 50 to 1000 horsepower, in two to eight cylinder units, an improved line of four-cycle direct injection moderate speed Diesel engines for stationary and marine services, recently has been introduced by the Worthington Pump and Machinery Corporation, Harrison, N. J. Among the many salient features of construction of these Diesels are: Individual fuel pumps for each cylinder, with fuel lines of equal length, hydraulically control the injection of fuel; individual air starting pilot valves control the admission of starting air to each cylinder; and spray valves are pressure actuated, no push rods or levers being used.

Of special interest is the fact that all of these Diesels easily can be converted to operation on manufactured or natural gas—the same base, frame, crankshaft and connecting rod is used. The camshaft is the same except that the fuel cams are omitted or not used if the engines are to operate on gas. When running on gas, a magneto and spark plugs replace fuel pumps and spray valves; a mixing valve is bolted to the end of the regular inlet manifold; and gas engine cylinders, with larger valves in the heads, are substituted.



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New York State Sewage Works Association

The New York State Sewage Works Association held its Fall Meeting at Saranac Lake, October 14-15, 1932, President Earle B. Phelps, presiding. Seventy-three members and guests were registered. The ladies continue their interest in these meetings, twenty-three being present.

Following registration Friday morning an inspection and sight seeing trip was made to the Lake Placid Sewage Treatment Plant, the Olympic Arena and the Olympic Bob Sled Run.

In the afternoon after a brief business session, three papers were presented. In the first "Approach to City Saved by Sewage Works—The Special Feature of Design, Construction and Operation of These Works," Henry W. Taylor described the works at Saranac Lake and brought out a number of points in design and operation that had been established. Ellis K. Phelps presented the joint paper by Earle B. Phelps and himself on "Studies of Sewage Disposal in a Harbor Involving Bathing Beach and Shellfish Pollution," describing the problem, the methods and results of their work. In the third paper, "Maintenance and Operation of the Sewer System and Sewage Treatment Works of the West Long Beach Sewer District," George Nesbit, Superintendent of Sewers of the West Long Beach Sewer District at Atlantic Beach, N. Y., discussed his problem in maintaining an extended sewer system with minimum grades, involving several lift stations and an ocean outfall and operating a sewage treatment works entirely below ground level.

The members and guests were guests of the village at an informal dinner in the Hotel Saranac. C. C. Trembley, M. D., presided as toastmaster and introduced Seaver A. Miller, Mayor of Saranac Lake. Mayor Miller in a delightfully informal talk gave his personal recollections of Saranac Lake and the central Adirondacks.

An innovation on the program was a so-called Sunrise Breakfast on Saturday, with fifteen ladies present who withdrew when Morris Cohn and C. C. Agar opened up the Question Box. The answers were short and snappy. Following this the meeting took up the Round Table Discussion with Vice-President A. F. Dappert presiding. Arnold Hale of Brighton opened the discussion on "Winter Operation of Sewage Treatment Plants"; F. A. Cary of Fairport and Harry Eustance of Ithaca on "Conditioning of Sludge in Separate Sludge Digestion Tanks"; and C. C. Agar on "Artificial Treatment of Sludge to Facilitate Drying."

The meeting unanimously adopted a resolution protesting against drastic or unproportionate reduction in maintenance funds for municipal sewage treatment works.

The meeting was brought to a close with an inspection trip to the Saranac Lake Treatment Plant.

The Fifth Annual Meeting of the Association will be held in New York City in mid-January, 1933.

The Eighth Annual Missouri Water and Sewerage Conference

The Eighth Annual Meeting of the Missouri Water and Sewerage Conference was held in Sedalia, Thursday and Friday, October 13-14, 1932. The registration was the largest ever recorded by the organization.

One formal paper was presented at the beginning of each half-day session of the meeting, the remainder of the session being devoted to round table discussion.

Thursday morning, after an address of welcome by Mayor Steeples of Sedalia, the first paper, entitled "What Operators in Water Purification Are Thinking About," was presented by Charles H. Spaulding of Springfield, Illinois. Following this paper, round table discussions on the following subjects were opened by the men indicated: When and How to Wash a Filter, by F. S. Hawken of St. Louis; Bacteriological Laboratory Control, by H. O. Hartung of University City and J. P. Smouse of St. Joseph; Chemical Laboratory Control, by Roger Higgins of Chillicothe; The Activated Carbon Treatment, by Frank Turner, Cameron, and Carl Haynes of Moberly; Prechlorination, by Cleo Brown of Harrisonville.

The Thursday afternoon session was opened with a paper entitled, "Determining the Proper Water Rates for Smaller Cities," by R. E. Duffy, of the State Public Service Commission, Jefferson City. After this paper, the following round table discussions were opened by the men indicated: Reconstruction Finance Corporation Loans for Water Works Improvements, by H. C. Delzell of Chicago, Illinois; Use of Copper Services, by W. B. Rollins of Kansas City; Painting Standpipes and Elevated Tanks, by H. E. Newell of Webb City; Routine Inspection of Fire Hydrants and Preparation for the Winter Season, by W. H. Henby of University City; Method of Preparing and Collecting Water Bills, by W. E. Barnes of Liberty.

The Friday morning session was devoted to a discussion of sewage treatment topics. At this session, a paper entitled "Recent Developments in Sewage Treatment" was presented by G. R. Scott of Kansas City. This paper was illustrated with motion pictures. Round table discussions on the following subjects were opened by the men indicated: Laboratory Control of Sewage Treatment Plants, by R. E. Fuhrman of Kansas City; The Collection of Gas for Heating Sludge, by George S. Russell of St. Louis; Sewer Rental Charges, by H. C. Delzell of Chicago, Illinois; The Degree of Treatment Necessitated by Various Types of Streams, by W. Scott Johnson of Jefferson City.

After the morning session, the Sedalia Water Company's filtration plant was inspected, and following a luncheon at the Sedalia Country Club, the Sedalia sewage treatment plants were inspected. Sedalia is served by two plants, one an Imhoff tank and trickling filter built in 1915, and the other a separate sludge digestion and trickling filter plant built in 1927.

At the final session on Friday afternoon, a paper entitled "Zeolite Softening of a Well Water Supply" was presented by A. W. Kirby of Marshall. After this paper, a round table discussion on "Economy Derived from Proper Selection of Pumps" was opened by Herman Henrici of Kansas City, and on "Small Iron Removal Plants" by E. S. Flannery of Platte City.

At the business meeting, the following officers were selected for the ensuing year: Chairman, W. E. Barnes, Liberty; Vice-Chairman, L. P. Andrews, Sedalia; Secretary-Treasurer, Herbert Bosch, State Board of Health, Jefferson City. Executive Committee: C. E. Hord, Louisiana; M. S. Hogan, West Plains; H. E. Newell, Webb City; Frank Turner, Cameron.

Here and There

Worriers, Inc.

The formation of Worriers, Inc., was announced by G. R. Kavanagh at a recent meeting of the Chattanooga (Tenn.) Engineers' Club. "The staff is composed of bankers and bankees, as well as many other professions which have developed some Grade A worriers recently. Branch offices will be set up in principal cities. We will render every service worriable, from slight frowns through floor-pacing and spasms; special worrying will include turning gray, weeping and wailing, head holding, hair tearing, gnashing teeth and window-jumping. Worriers, Inc., will be rude to innocent persons for a small fee, and will insult friends for slightly more."

The rates are based upon 15-minute intervals of worrying, and increase with the square of the time, due to the hardship which sustained worrying imposes on the staff.

The new organization guarantees, under bond, to produce the same results that would be accomplished by personal worrying—None.

Applications for positions on the staff of the new organization, accompanied by a statement of experience qualifications, may be sent to Box W, this office, or direct to the Engineers' Club of Chattanooga, Tenn.

Personal and Industrial News

Burns & McDonnel Engrg. Co., Kansas City, Mo., have opened an office at 612 Dixie Terminal Bldg., Cincinnati, O. The office will be in charge of C. F. Lambert, a member of the firm, with H. J. Rosson as office manager.

H. H. Elmire, who until recently has been in charge of the New York District Office at Arlington, N. J., of the Keystone Driller Company, has been promoted to Field Engineer for the same company, with headquarters at Beaver Falls, Pa. James Shearer takes his place as District Manager at Arlington.

J. E. McFate, formerly of the Jones & Laughlin Steel Corp., has been appointed New England representative for the Republic Steel Corp., Youngstown, O., with headquarters in Boston.

H. B. Fuller Equipment Co., 520 Union Bldg., Cleveland, O., has been appointed distributor in Northeastern Ohio for Link-Belt shovels, cranes and draglines.

An arrangement has just been made for the joint use of the manufacturing, sales and service facilities of the Meter Division of Worthington Pump and Machinery Corporation and those of the Gamon Meter Company, whose plant is located at 282-296 South Street, Newark, N. J. The sales staffs of both organizations will report to and be directly responsible to George H. Gleeson, who will head up the meter sales activities of both companies.

Catalogs Received:

"Pumps, Hoists, Ditchers and Saw Rigs." C. H. & E. Mfg. Co., Inc., Milwaukee, Wisc., has redesigned its complete line and issued a new catalog which shows the first texrope "V" belt drive hoist on the market, eliminating all noise and clashing of gears. A new improved No. 11 Triplex road pump with texrope drive between pump and engine; which, together with the extra heavy construction throughout, eliminates all vibration and stress even at high pressures. A complete line of new improved self-priming centrifugal and sewage and trash pumps is also featured.

"Flow Measurement."—A bulletin describing a simple and accurate device for measuring the flow of liquids. The Isometer Co., 2357 No. 29th St., Milwaukee, Wisc.

On Mississippi Levees.—An interesting Bulletin of flood control work put out by Allis-Chalmers, Milwaukee, Wisc.

Caterpillar "35".—A new catalog describing the Caterpillar "35" successor of the well-known "30." Caterpillar Tractor Co., Peoria, Ill.

"Road Machinery."—Road Discs, Road Rooters and Self-Loading Scrapers are described in bulletins 514, 520 and 295A, respectively, of the Baker Mfg. Co., Springfield, Ill.

Protective Coatings.—A new catalog and data book on protective coatings for iron, steel, wood, brick and concrete has been put out by the Quigley Co., 56 W. 45th St., N. Y.

Acid-Proof Paints:

A new line of rubber paints which has been developed very recently is discussed in a recent bulletin of the B. F. Goodrich Rubber Company, Akron, Ohio. Titled "Acidseal Paints" the bulletin is a manual of recommendations for paint problems and tells about rubber derivatives that minimize the corrosive action of acids and alkalies on materials, and are characterized as follows: (1) Exceptional properties of adhesion when applied to a properly prepared surface. (2) Dry in one hour to a hard firm film but retain to a remarkable degree the elastic properties of rubber and consequently conform to the expansion and contraction of the support. (3) Retaining the well known chemically resistant properties of rubber, they provide a protective coating that minimizes the corrosive action of acids, alkalies and chemical fumes. Film is not water absorbent.

The bulletin discusses selection of proper paint and primer for various purposes, methods of application, ingredients, describes finished results, spreads per gallon and operations in which different types have been used successfully.

Copies of the bulletin may be had on request to the manufacturer. Please mention PUBLIC WORKS when asking for them.

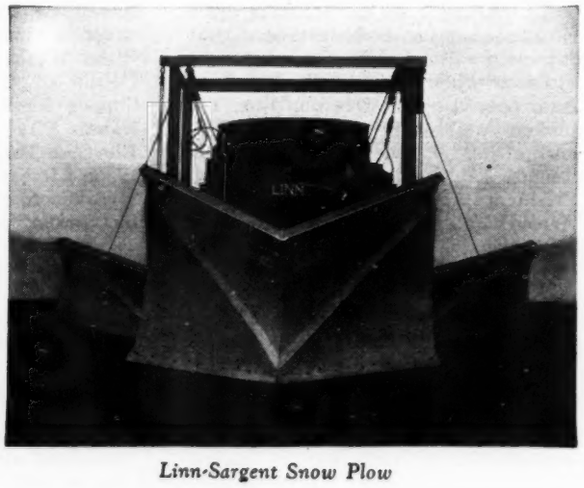
Caterpillar Stationary Engines:

The Caterpillar Tractor Co., Peoria, Ill., has just issued bulletins describing their 4200-G power unit, which is the stationary version of the engine which powers the "25" tractor; and the 9000-G, which is the same as the "65" tractor engine.

Linn-Sargent Hi-Wing Snow Plow

The Linn Manufacturing Corporation, Morris, N. Y., has announced a new Sargent hydraulically operated snow plow designed especially for use with the Linn, to enable it to apply its power for snow removal. Three levers lift the V and control the wings and both ends of the wing push arms. The power comes from a hydraulic pump mounted on the power take-off of the tractor. The wings may be kept flat for planing or sloped up for setting back banks. Whatever their position at the top of the lift they are always flat when on the ground. They can also be folded in out of traffic or lifted so high that an automobile can drive under them. There is no piping between the tractor and the plow. The plow and wings can be de-mounted by pulling ten pins—a few minutes' work. The Sargent Super-suction Cutter Bars (patented) make the plow cut clean and the shape of the V as shown below makes it "lift" the snow and penetrate with maximum ease. The hook-up is so designed that the plow cannot "jackknife." The big hydraulic jacks are powerful enough to lift the wings against snow without stopping the tractor, so that the wing man can keep the wing and nose in constant balance when plowing side banks of varying heights.

One of a fleet of 64 International Motor Trucks in service of the Iraq Petroleum Co. among the rocks of Iraq. The picture shows the type of country in which work must be done.



Linn-Sargent Snow Plow

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INDUSTRIAL LITERATURE

WILL BE SENT **FREE** UPON REQUEST

★ *It is a good practice to check this list regularly because descriptions of new bulletins are always being added.*

Construction Materials and Equipment

Accessories for Motor Trucks

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate. J. D. Farasey Mfg. Company ,Cleveland, Ohio.

Asphalt Rollers

12. How to use Rollers to Save Tamping Costs. 16-page booklet gives details and also specifications of the Erie Roller. Issued by the Erie Machine Shops, Erie, Pa.

Bins and Hoppers

20. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Clamshell Buckets

27. Clamshell Buckets, showing the various types, sizes and uses for which they are intended, and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request. The Owen Bucket Company, Cleveland, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size. The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Explosives

74. "Use of Explosives for Settling Highway Fills." A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Galion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Galion Iron Works & Mfg. Co., c-o The Jeffrey Mfg. Co., Columbus, Ohio.

77. "Blade Graders" is a 48 page booklet, recently published by the Caterpillar Tractor Co., Peoria, Ill., giving the complete details of "Caterpillar" graders.

78. The No. 101 Austin Leaning Wheel Grader is completely detailed and illustrated in Bulletin No. 1238 which shows operation of Z-Bar, back sopper, bank cutter, etc. Published by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

79. Austin No. 77 Dual Drive Motor Graders are completely illustrated and described in Bulletin No. 1239 which also contains construction details, specifications and weights. Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Lanterns and Torches

90. Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. A new line of heavy duty motor trucks and tractors for dump and commercial hauling is described in literature recently issued by the Sterling Motor Truck Co., Milwaukee, Wis.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

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11-32

108. "Keeping Trucks in Condition for Keeping the Highways Open," a comprehensive, 32-page, illustrated booklet containing much valuable information on the proper care of snow removal equipment to prolong its life. Issued by Dept. B, the Four Wheel Drive Auto Co., Clintonville, Wis.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Construction

122. "Road Building Machines" is a handy reference booklet to the complete line of "Caterpillar" road machinery. 40 pages.

Road Machinery

125. The following publications cover a wide range of valuable and useful information on road-building machinery. Sixty Leaning Wheel Grader, the Super-Special Grader, the Motor Patrols, the Twenty-Planer, the Hi-Way Patrol Grader No. 3, the Ten Motor Patrol, and the Auto Patrol Caterpillar Tractor Co., Peoria, Ill.

126. A new picture book of the Austin-Western Line of road machinery showing the application of road graders, road rollers, elevating graders, crawler and wheeled wagons, crushing and screening plants, shovels, cranes and excavators, scarifiers and many small tools, is contained in Catalog No. 1247. Copies available on request at The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

Elevating Graders

129. An interesting booklet on Elevating Graders has recently been issued by the Caterpillar Tractor Co., Peoria, Ill.

Rollers

131. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Erie Machine Shops, Erie, Pa.

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses. The Buffalo-Springfield Roller Company, Springfield, Ohio.

134. "Road Rollers." Illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Galion Iron Works and Manufacturing Co., Galion, O.

135. 36-page, illustrated book describing the application of Motor Rollers to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Sand and Gravel Buckets

137. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

144. Complete information including operating ranges of General Excavators is given in Bulletin No. 3105 recently prepared by The General Excavator Co., 365 Rose St., Marion, Ohio.

145. The Austin Badger, a new, fully convertible ⅜ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" transits and levels are described and illustrated in a 64-page booklet. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

164. Booklet on the most popular types of Transits and Levels in general use by Engineers and Surveyors, giving full information on the sizes and styles of these instruments. Issued by C. L. Berger and Sons, Inc., 37 Williams St., Boston 19, Mass.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Tractors, Crawler

171. The design, construction, details and complete specifications of the Ten and Fifteen models "Caterpillar" are given in a booklet published by the Caterpillar Tractor Co., Peoria, Ill.

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

175. Caterpillar Tractors. The "Fifty;" the "Thirty-five;" the "Twenty-five." Full data on these models. Caterpillar Tractor Co. Peoria, Ill.

Road and Street Maintenance

Asphalt Heaters

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Highway Maintenance

216. "Light and Heavy Road Maintenance" describes fully the FWD truck and its economy for use in pulling road graders and maintainers—issued by Dept. B, Four Wheel Drive Auto Company, Clintonville. Wisconsin.

218. "Maintenance Machines," a 32 page booklet, tells of "Caterpillar's" complete line of maintenance machines—3 sizes of motor patrols, a trailer patrol and planer—including machines to fit all pocketbooks and all road maintenance conditions. Caterpillar Tractor Co., Peoria, Ill.

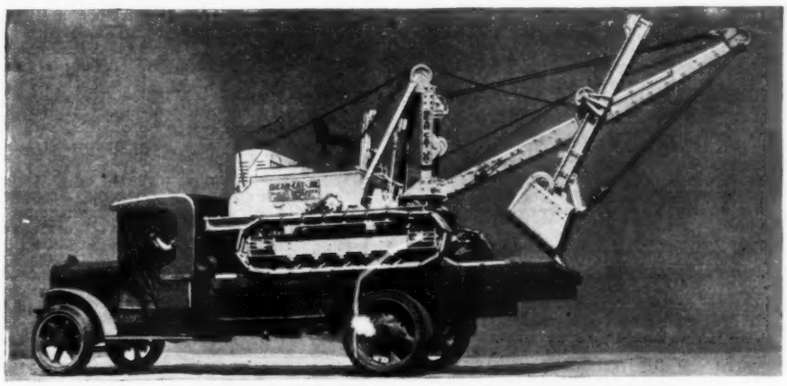
Surface Heaters

225. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Construction Kinks and Equipment

Transport 3/8 Yard Shovel on Truck From Job to Job

The Bear Cat Jr., a new 3/8 yard convertible shovel, which is light enough to mount and transport on a heavy duty motor truck, is announced by The Bearcat Shovel Works, a division of The Byers Machine Company, Ravenna, Ohio. It uses only 10 gallons of gasoline per day in steady digging, and weighs only 6½ tons.



Transporting a Small Power Shovel on a Truck.

Its special design and construction features make it particularly adaptable to road maintenance, loading and unloading operations, basement excavation, gravel and clay bank work, trenching, back filling and light hook block jobs.

Because the Bear Cat Jr. sells for much less than even a heavy duty dump truck, its price comes within the purse of many contractors, counties, townships and municipalities who could not before afford to purchase new heavy equipment.

A new 24-page, illustrated booklet "How to Dig Dirt at Lower Cost" describes this machine and shows many of the ways to use it. Free copies are available by writing to The Bearcat Shovel Works, Ravenna, Ohio. Please mention PUBLIC WORKS.

Sand and Gravel Spreading

A truck load of sand properly equipped with a spreader can eliminate icy street crossings in the average city in two hours, and is also valuable for applying sand to oiled roads, and gravel or other material in construction work. Requirements for a good spreader are even distribution, and ability to regulate the width and amount of spread as desired. The Holden Co., Peoria, Ill., make a variety of spreaders and spreader attachments suitable for handling calcium chloride, sand, gravel, lime, grass seed, fertilizer.

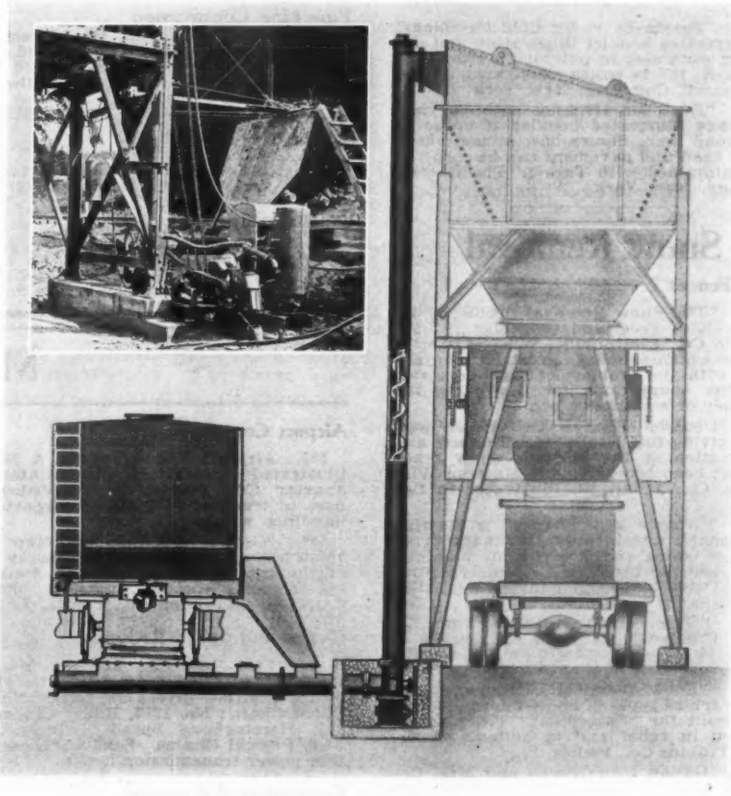
A New 2-Line Concrete Bucket

Blaw-Knox Company, Pittsburgh, Pa., has developed a new form of concrete bucket, as shown in the illustration. This is rated as a 2-cubic yard bucket, but its actual capacity is 62 cubic feet. A bucket of this type meets many requirements on public works, or other construction, where large quantities of concrete are being used; where concrete is being placed subaqueously, a bucket of this character is almost indispensable.

2-Line Type of Concrete Bucket.

Reducing Handling Costs on Bulk Cement

Bulk cement has many advantages in use, among them being elimination of sacks and lower first costs. A screw elevator handles the bulk cement from the car to the bins at a cost, exclusive of depreciation of equipment, of 2 to 2½ cents a barrel. The apparatus can be operated by one man, is dust-tight and water-proof. It can be moved easily from one job to another and set up quickly. It can unload from any type of car or truck. The outfit shown herewith was manufactured by Sprout-Waldron & Co., Muncy, Pa.



Layout for Handling Bulk Cement Economically.

Road and Paving Materials

Bituminous Materials

227. "Asphalt for Every Purpose" a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with 'Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

Snow Removal

Snow Fences

346. "The Snow Removal Problem," by W. A. Olen, Pres. and Gen. Mgr., F. W. D. Auto Co., Clintonville, Wis., is a brief booklet which should interest all who are faced with the problem of snow removal. Contains suggestions for improving the efficiency of equipment, etc.

347. "Control Winter Drifts"—A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Joliet, Ill. Illustrated in two colors.

348. "Winter Maintenance" is the title of a booklet which illustrates many types of snow plows and methods of handling snow removal problems. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

354. "Snow Removal Equipment" pictures various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action. Caterpillar Tractor Co., Peoria, Ill.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 300 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

Glass-Overs

393. Full details regarding the use of Lord & Burnham Glass-Covers at Dayton, Ohio; Highland Park, Ill.; Fostoria, Ohio; and Bloomington, Ill. are given in bulletins Nos. 10, 11, 14, 15. Issued by Lord & Burnham, Graybar Bldg., New York, N. Y.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

403. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

407. New "Handbook of deLavaud Centrifugally Cast Iron Pipe" contains useful information for the water works man including revised specifications together with dimensions and weights of deLavaud pipe in accordance with Federal Specifications for Pipe; Water, Cast-Iron (Bell and Spigot) N. WW-P-421. Just issued by the U. S. Pipe and Foundry Co., Burlington, N. J.

Pipe Line Construction

410. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Pumps, Centrifugal

415. Design data for centrifugal pumps for high or low service pumping for waterworks and filtration plants. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

Pumps, Self-Priming

416. "Make your present pumps self-priming." Bulletin No. 530 B describing the Hazleton Suction Line Primer which can be applied to old as well as new pumps regardless of make. Issued by Barrett, Haentjens & Co., Hazleton, Pa.

Pumps—Sewage

417. Non-clog vertical and horizontal sewage pumps and their characteristics are described and illustrated in bulletins of the Dayton-Dowd Co., Quincy, Ill.

Screens, Sewage

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

427. Bulletin GE31 describes Glass Enclosures for Sludge Beds in detail. Specifications, cross sections, details and illustrations shown are of value to engineers and officials. Sent promptly upon request. American-Moninger Greenhouse Mfg. Corp., Dept. B, 1947 Flushing Ave., Brooklyn, N. Y.

Treatment

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.

Water Development

440. Complete details of the Layne System of water development for municipalities and irrigation projects, based on deep wells and turbine pumps. Layne & Bowler, Memphis, Tenn.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar,'" describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., Peoria, Ill.

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books No. 125 Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Transits and Levels

629. A booklet giving full information on the sizes and styles of Berger Transits and Levels will be sent promptly by C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.

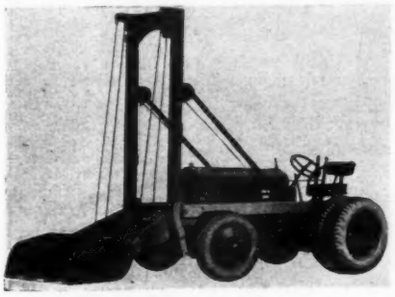
630. Transits and Levels particularly adapted for City, County and State work are described in a 64-page catalog. Warren-Knight Co. 136 No. 12th St. Philadelphia, Pa.

Wire Rope

634. Williamsport Wire Rope Co., Chicago, Ill., has issued a folder illustrating their new method of "preseating."

Pettibone Mulliken Fabriform Loaders

The Industrial Equipment Division of Pettibone Mulliken Company, 4710 West Division Street, Chicago, announce the Fabriform loader for operation with McCormick-Deering Industrial tractors. The Fabriform loader, manufactured by the Welded Products



Fabriform Loader

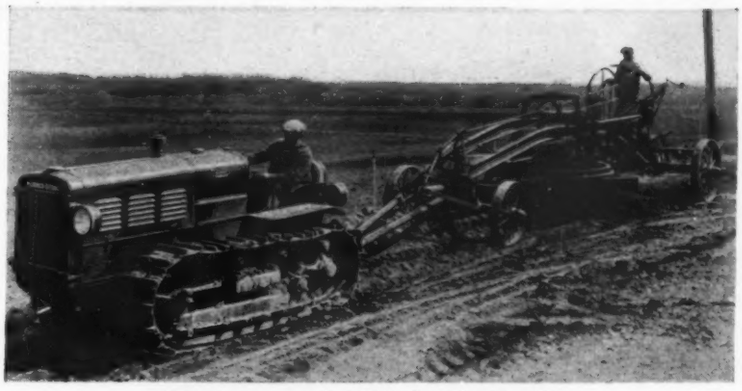
Company, Los Angeles, is a fast, economically-operated loader for all types of dirt and material-handling jobs. It is light weight and constructed so that the operator has an unobstructed view, both ahead and to the rear of the tractor. The loader, which is mounted on the McCormick-Deering Industrial Tractor, is readily maneuvered and applicable to road building, railroads, building construction, municipal, public utility, airport, snow removal and similar work where heavy and bulky materials are handled.

One of the outstanding features is the high-lift and long-loading reach features. It has a loading height of 8½ feet and will load any 2-ton truck entirely from the rear. The loader bucket is ½-yard capacity and has a traveling speed of 68 feet per minute. The Fabriform loader can be operated with a tractor equipped with either wheels or Moon Tracks.

Finishing Highway Shoulders

The shaping of shoulders along paved highways, heretofore a slow and costly process, has been simplified by the use of a combination shouldering attachment which transfers the dirt into an elevating grader, which loads into trucks. The shouldering attachment is attached to the elevating grader in place of the plow, and can be fitted to machines in the field. This device works with a screw conveyor and gives a surface that is absolutely smooth. The device was developed by the Western Wheeled Scraper Co., Aurora, Ill.

Finishing Highway Shoulders.

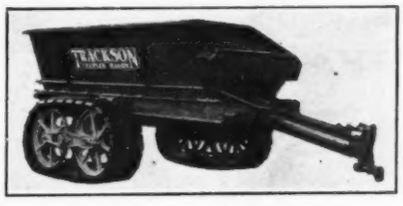


The International 6-Cylinder TracTracTor

Economy Through Larger Equipment

A crawler wagon designed for dragline loading to carry 11 cubic yards, heaped, has been used on the Mississippi Levee work and found to be economical. It is designed for use with the larger draglines and crawler tractors on larger dirt-moving projects. The Levee Special shown is put out by the Trackson Co., Milwaukee, Wisc.

Trackson Levee Special



Another Trackson Wagon

A New Heavy 6-Cylinder Tractor

The new Model T-40 six-cylinder TracTracTor has just been announced by International Harvester. It is a bigger and more powerful unit than the Model T-20 TracTracTor. The T-40 develops a maximum drawbar horsepower of 40 and a maximum engine horsepower of 52 as compared to the maximum drawbar horsepower of 23 and a maximum engine horsepower of 31 for the T-20. It is especially well suited for a variety of heavy construction work where lots of push and pull power are required, such as road, dam, levee, irrigation and oil-field work. In operating bulldozers, backfillers, shovels, and snowplows and pulling crawler wagons, scrapers, and graders, the new crawler is at its best.

Accessibility of working parts of the new T-40 TracTracTor is worthy of particular mention. Steering clutches, transmission, and brakes may be easily inspected, adjusted, or removed through top and rear cover plates, making for surprisingly low maintenance cost. Special dust seals guard every shaft and bearing. The light weight per unit of track area and ample power available fit it for heavy hauling and pushing work over fine sand and soft, mucky soil; over rough, rocky places; and up and down steep slopes. The tractor is easy to operate, for all controls are within ready reach of the driver and there is an unobstructed view from the tractor seat.

This unit is made by the International Harvester Co., Chicago, Ill.

This shows the Galion pneumatic-tired one-man grader with Case power unit, equipped with Galion hydraulic control. All adjustments of the moldboard and scarifier are controlled by three easy moving levers. There are no cranks or wheels to turn.

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When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 61 and order by number.

STATE DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
ALBANY, N. Y.

Sealed proposals will be received by the undersigned at the State Office Building, 13th Floor, Albany, N. Y., until one o'clock p. m. on Tuesday, November 15th, 1932, for the construction of highways in the following counties:

	Deposit Required
COLUMBIA (Prel. Gravel Surf: 6.62 miles)	$12,000.00
NASSAU (Gas Stations)	3,500.00
NASSAU (Concrete & Bit. Mac. M. M. Type 5: 2.52 miles)	10,000.00

Also for the reconstruction of the following:

ERIE (Cons. & Recons.) (Concrete & Bit. Mac. M. M. Type 3: 6.53 miles)	17,000.00
MONROE (Cons. & Recons.) (Concrete & Bit. Mac. M. M. Type 3: 5.10 miles)	12,000.00
STEUBEN (40' I-Beam Bridge)	600.00

Maps, plans, specifications, and estimates may be seen and proposal forms obtained at the office of the Department in Albany, N. Y., and also at the office of the District Engineers in whose districts the roads are located, upon the payment of Five Dollars ($5.00) for plans and proposal forms. Standard specifications are Two Dollars ($2.00) per copy. Refund will not be made on plans, proposal forms or specifications. The addresses of the District Engineers and counties in each district will be furnished upon request. Plans and proposal forms may also be seen at the office of the State Department of Public Works, State Office Bldg., Worth & Center Streets, New York City.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications, and contract agreement.

A. W. BRANDT,
Commissioner of Highways.